METALS & ALLOYS

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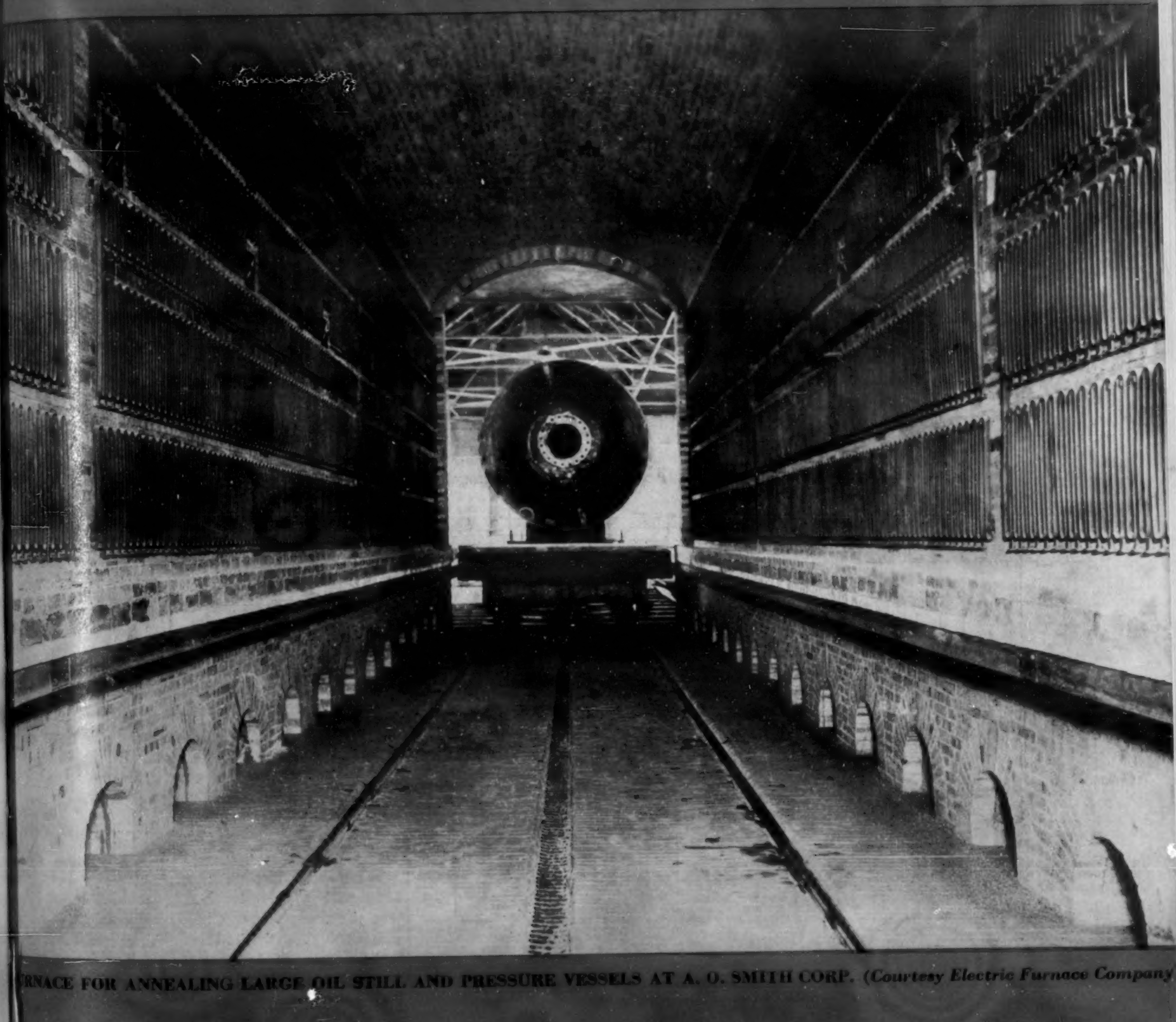
The Magazine of Metallurgical Engineering

INCLUDING

CURRENT METALLURGICAL ABSTRACTS



RNACE FOR ANNEALING LARGE OIL STILL AND PRESSURE VESSELS AT A. O. SMITH CORP. *(Courtesy Electric Furnace Company)*

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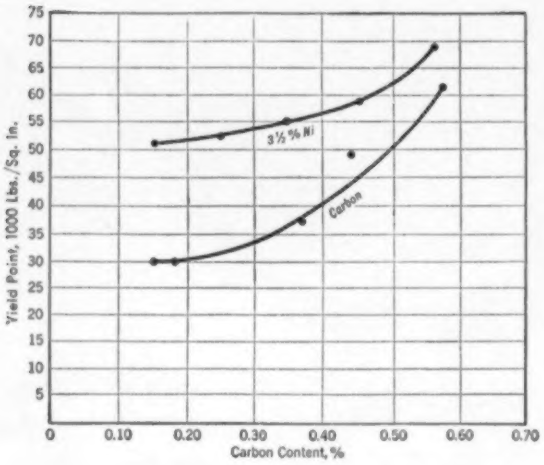
NICKEL ALLOY STEEL FORGINGS

Larger than 4 inches in diameter or equivalent section

Uses

Forged alloy steels are employed for large shafts, turbine motor and generator drums, gears, flywheels, pressure chambers, die blocks, Diesel engine parts, locomotive forgings, axles, extrusion dies, rolls and parts of steel mills, steam-hammer piston rods, hydraulic press rams, etc. In general, large forgings of this kind are used for parts of heavy machinery where strength and toughness, high impact and fatigue resistance and reliability are required.



Comparison of Normalized Nickel Steel and Carbon Steel Forgings

Properties

Large forgings vary in shape and in size, and to attempt roughly to classify them by size necessarily results in generalization The purchaser may reasonably expect higher properties than are guaranteed, unless his forgings are extreme in size or intricacy. Table I gives, for large nickel alloy steel forgings, specifications which are considered standard; the properties which may reasonably be expected from what might be called the "average" of each group; and concrete examples of properties which have actually been obtained in practice.

Type	Carbon	Manganese	Nickel	Chromium	Molybdenum	Vanadium	Remarks
3% Nickel	0.13-0.50	0.40-0.80	Min. 3.00	..	..	..	General structural, for strength and toughness.
2.5% Nickel	0.18-0.35	0.60-0.90	Min. 2.50	..	..	..	Intended for normalized forgings.
Nickel-Chromium	0.25-0.45	0.40-0.80	2.75-3.50	0.60-0.95	..	..	Heat treated usually by quench and temper.
Nickel-Chromium	0.28-0.42	0.40-0.70	Min. 1.25	Min. 0.70	..	..	Slightly lower properties.
Nickel-Chromium	0.25-0.50	0.40-0.80	2.75-3.50	1.25-1.75	..	..	For higher tensile values.
Nickel-Chromium	0.20-0.45	0.40-0.80	Min. 4.50	1.25-1.75	..	..	"Krupp Analysis" for very high tensile values.
Nickel-Molybdenum	0.25-0.40	0.60-0.90	2.00-3.00	..	Min. 0.30	..	Suitable for normalizing or quenching.
Nickel-Chromium-Molybdenum	0.25-0.40	0.40-0.80	2.00-3.00	0.60-0.95	0.30-0.60	..	Suitable for normalizing or quenching.
Nickel-Vanadium	0.18-0.45	0.60-0.90	1.75-2.25	..	..	Min. 0.15	Suitable for normalizing or quenching.
Nickel-Chromium-Molybdenum-Vanadium	0.25-0.70	0.40-0.80	1.25-1.75	0.50-1.00	0.20-0.30	Min. 0.15	High values.

Phosphorus and Sulphur usually specified under 0.045%

Table II. Nickel Alloy Forging Steels

Manufacture

It is usually specified that the steel may be made by any process—acid or basic open-hearth, acid or basic electric furnace. Each process has some advantages and there is not an overwhelming argument advanced for any one. The electric furnace, however, does not contribute a large tonnage, due to the comparatively small size of most electric furnaces.

Whenever possible, forgings should be axially bored. There is a fourfold reason for this. The physical properties are benefited by the increased rate of cooling; the material at the axis is not particularly valuable from an engineering standpoint as the stresses are lowest here; the metal which is inherently the poorest is removed and the resulting bore affords an opportunity for internal inspection which is very desirable.

Heat Treatment

All large forgings should be heat treated before delivery. The treatments used are the three standard ones of annealing, normalizing and quenching and tempering, but it is imperative that consideration be given to the masses involved and stresses set up. For very large forgings, say forty inches in diameter or equivalent section, the normalizing treatment is generally the only one used. To break up ingotism the heat treater often resorts to a high temperature normalizing treatment, usually between 1800 and 2000 degrees Fahr. and of long duration.

Nickel lowers the critical ranges of the steel to which it is added. This is advantageous as there is less liability to increased grain growth at the lower heating temperatures and also less liability to warpage and internal stresses on quenching. Nickel steels are not injured, but improved, by long soaking in the critical range.

Type	Treatment	Size	Tensile Strength	Elastic Limit	Elongation in 2" Min. %: Inverse Ratio	Elongation in 2" Min. %: Min. %	Reduction of Area: Inverse Ratio	Reduction of Area: Min. %	Reasonable Expectation: Tensile Strength	Reasonable Expectation: Elastic Limit	Reasonable Expectation: Elongation	Reasonable Expectation: Red. of Area
Carbon	Annealed	up to 8" dia.	75,000	.5 Tens. Str.	1,800,000 Tens. Str.	20.0	2,800,000 Tens. Str.	33.0	75- 78,000	40-43,000	25.0	47.0
Carbon	Annealed	8"-12" dia.	75,000	.5 Tens. Str.	1,725,000	19.0	2,640,000	31.0				
Carbon	Annealed	12"-20" dia	75 000	.5 Tens. Str.	1,650,000	18.0	2,400,000	29.0				
Carbon	Q & T	up to 4"-2" Max. Wall	90,000	55,000	2,100,000	20.5	4,000,000	39.0	90- 95,000	55-60,000	23.0	45.0
Carbon	Q & T	4"-7" 3½" Max. Wall	85,000	50,000	2,000,000	20.5	3,800,000	39.0				
Carbon	Q & T	7"-10" 5" Max. Wall	85,000	50,000	1,900,000	19.5	3,600,000	37.0				
Carbon	Q & T	10"-20" 5"-8" Max. Wall	82,500	48,000	1,800,000	19.0	3,400,000	36.0				
Carbon	Normalized	10"-20" dia.	83,000	43,000	....	22.0	....	35.0	75- 85,000	40-45,000	23.0	43.0
3% Nickel	Annealed	up to 12" dia.	80,000	50,000	2,000,000	22.0	3,600,000	40.0	80- 90,000	50-55,000	25.0	47.0
3% Nickel	Annealed	12"-20" dia.	80,000	50,000	1,900,000	21.0	3,400,000	38.0				
Low Carbon 2.5% Nickel	Normalized	10"-20" dia.	80,000	55,000	....	27.0	....	58.9	83- 90,000	57-65,000	28.0	52.0
3% Nickel	Q & T	up to 4"-2" Max. Wall	100,000	70,000	2,200,000	20.0	4,500,000	41.0	100-110,000	70-80,000	23.0	45.0
3% Nickel	Q & T	4"-7" 3½" Max. Wall	100,000	65,000	2,100,000	20.0	4,300,000	41.0				
3% Nickel	Q & T	7"-10" 5" Max. Wall	90,000	60,000	2,000,000	20.0	4,100,000	41.0				
3% Nickel	Q & T	10"-20" 5"-8" Max. Wall	85,000	55,000	1,900,000	20.0	3,900,000	41.0				
3% Nickel	Normalized	10"-20" dia.	90,000	60,000	....	22.0	....	40.0	90- 95,000	60-65,000	25.0	45.0
*Ni.-Cr. Type K	Q & T	4"-7" dia. 3½" Max. Wall	90-110,000	65,000	....	20.0	....	50.0				
*Ni.-Cr Type K	Q & T	7"-10" dia. 5" Max. Wall	90-110,000	65,000	....	20.0	....	50.0				
*Ni.-Cr Type K	Q & T	10"-20" dia. 5-8" Max. Wall	85-105,000	60,000	....	20.0	....	50.0				
*Ni.-Cr. Type L	Q & T	4"-7" dia. 3½" Max. Wall	100-120,000	75,000	....	20.0	....	50.0				
*Ni.-Cr. Type L	Q & T	7"-10" dia. 5" Max. Wall	100-120,000	75,000	....	18.0	....	45.0				
*Ni.-Cr. Type L	Q & T	10"-20" dia. 5-8" Max. Wall	95-115,000	70,000	....	18.0	....	45.0				
*Ni.-Cr. Type M	Q & T	4"-7" dia. 3½" Max. Wall	110,000	85,000	....	16.0	....	45.0				
*Ni.-Cr. Type M	Q & T	7"-10" dia. 5" Max. Wall	100,000	75,000	....	18.0	....	45.0				
*Ni.-Cr. Type M	Q & T	10"-20" dia. 5-8" Max Wall	100,000	70,000	....	18.0	....	45.0				

*Table I. Specifications and Properties of Nickel Alloy Steel Forgings**

*Note: In the accompanying table of specifications, certain steels are designated "K," "L" and "M" types. This is in conformance with the specifications for carbon and alloy steel forgings of the American Society for Testing Materials (A18-27). Their compositions are not specified. The required physical properties can be obtained from the nickel-alloy steels listed above.

Sources of Supply

Large nickel alloy steel forgings are regularly produced by leading manufacturers who are ready to assist in the selection of compositions best suited to meet particular requirements. If the improved properties of nickel alloy steel forgings are of interest to you we shall be glad to put you in touch with established sources of supply.

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CURRENT METALLURGICAL ABSTRACTS

EDITORIAL COMMENT

Standing Room Only

WITH 400 to 500 in attendance at the annual Opening Meeting of the Metallurgical Advisory Board at Carnegie Tech. in the fall, and "standing room only" available both at the morning "high brow" session and the afternoon steel-making session, industry again showed its interest in the work. There was reason for this attendance, since good work was clearly presented. Herty, Mehl and Krivobok are among our very best speakers on metallurgical subjects, and always present even a complicated subject in the simplest possible terms. Then, too, there is an informality in the presentation of progress reports as contrasted with formal reports of finished investigations, that creates an atmosphere that is pleasing to the audience.

The work reported was an interesting combination of investigations in pure science—on very pure Fe-Mn-C alloys, and on segregation of ferrite and cementite from austenite—with no special or direct commercial aim, and of those in engineering metallurgy—on deterioration of 18-8 at high temperatures and on deoxidation of steel, in which the problems are commercial ones and pressing ones at that, and in which the attack is primarily from the engineering point of view, though it may and does involve going back as far into pure science as may be necessary to bring out the unknown but needed basic information.

It is interesting to note that the pure science work is supported by Carnegie Tech. through its Bureau of Metallurgical Research, the 18-8 work was a by-product of instruction in research methods in the Graduate School, and the deoxidation work is directly supported by industry through the Metallurgical Advisory Board.

This is a sane distribution, since pure research is essentially the duty of educational institutions, instruction should have the balance between pure science and commercial application that was shown in the work on 18-8, and industry ought to handle its own operating problems as is the case in the work on deoxidation.

We were interested when Dr. Johnston read Dr. Bain's suggestions on certain extensions of the work on segregation of cementite and ferrite from austenite that would tie in directly with some commercial problems. He evidently recognizes the attempts of the pure scientist to aim his work at the elucidation of fundamental problems that arise from commercial needs. That the set-up for the work of the Bureau of Metallurgical Research includes people like Dr. Johnston who can and do see the intimate connection between high-brow work and commercial problems, is also just as it should be.

Dr. Speller and the rest of the Metallurgical Advisory Board should be gratified with the progress of Dr. Herty and his associates in 1932. Although working on a reduced budget, without the financial support of, or the use of the facilities of, the Bureau of Mines which they had up to 1932, they produced the usual output both in quantity and quality. Perhaps the most pleasing thing of all was the testimony of several who discussed the reports, that by the use of the deoxidizers advocated by Herty for quality's sake, they had cut their costs.

This fact, plus the interest and enthusiasm shown at the meetings and the dinner which followed augurs well for the continuation of the work, though the work of the Finance Committee is no sinecure just now. However, we may safely class the Physical Chemistry of Steel Making among the outstandingly successful coöperative projects in metallurgical research.

There are other coöperative projects of importance in operation or in prospect, and those interested in them might well study the method of operation that has worked so well in this case.—H. W. GILLETT

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READERS' COMMENT

Steel in the Light of the Precipitation Theory

By ALBERT SAUVEUR

I am much gratified that my short article in the August number of "Metals and Alloys" under the title, "Steel in the Light of the Precipitation Theory," should have induced Mr. Roy M. Allen and Messrs. R. G. Guthrie and J. H. Comstock to write the important contributions to the subject published in the October issue under their respective headings: "The Precipitation Theory of Steel Hardness," and "On the Formation of Lamellar Pearlite." The wish that my remarks would result in constructive criticisms has thus been fulfilled, and it is hoped that others will take part in this discussion.

Admitting with Mr. Allen the probability that atomic carbon rather than molecular Fe_3C is in solid solution in γ-iron, I find no great difficulty in conceiving the precipitation of the carbide as immediately following its formation, either leisurely when γ-iron transforms to α-iron on slow cooling at some 700°C. or very rapidly on quenching at some 300°C.

It is indeed interesting that Mr. Allen should revive the diamond theory of the hardening of steel. That under suitable conditions of temperature and pressure diamonds of microscopic size can be produced in highly carbonized alloys can hardly be denied. We have only to recall the work of the great French chemist, Moissan, who in the latter part of the 19th century succeeded in producing some very small diamonds.

The theory was advanced by some that the hardness of quenched steel was due to the presence of numerous fine diamond particles produced in the quenching bath. In his book, "The Metallurgy of Steel," published in 1890, the late Prof. Henry M. Howe refers to this theory in the following words:

> This explanation (the diamond theory), hardly competent to explain a single phenomenon of hardening and utterly incompatible with many of them, merits notice solely because its discussion and even commendation by those who should have gauged it better has given it fictitious value. Briefly sudden cooling has been supposed to harden steel by converting its carbon into diamond. It is certain that hardened steel does not contain diamond, because none is found in the residue from dissolving it, even in dilute acids.

It is evident that as conceived the diamond theory was quite untenable. In those days hardening through the dispersion of a solute in submicroscopic particles had not been suggested. Considered from this new point of view, as Mr. Allen does, the diamond theory assumes a different aspect.

Mr. Allen argues that when austenite transforms, carbon in the form of submicroscopic diamond may be dispersed as well as carbide particles and may contribute to the hardness of quenched steel. Seeing that microscopic diamonds may be obtained in iron-carbon alloys, it would not be justified to claim that submicroscopic diamonds cannot exist. Indeed it is more logical to infer that the microscopic dimension must of necessity be preceded by the submicroscopic dimension, that in the growth of crystals the submicroscopic stage must precede the microscopic stage.

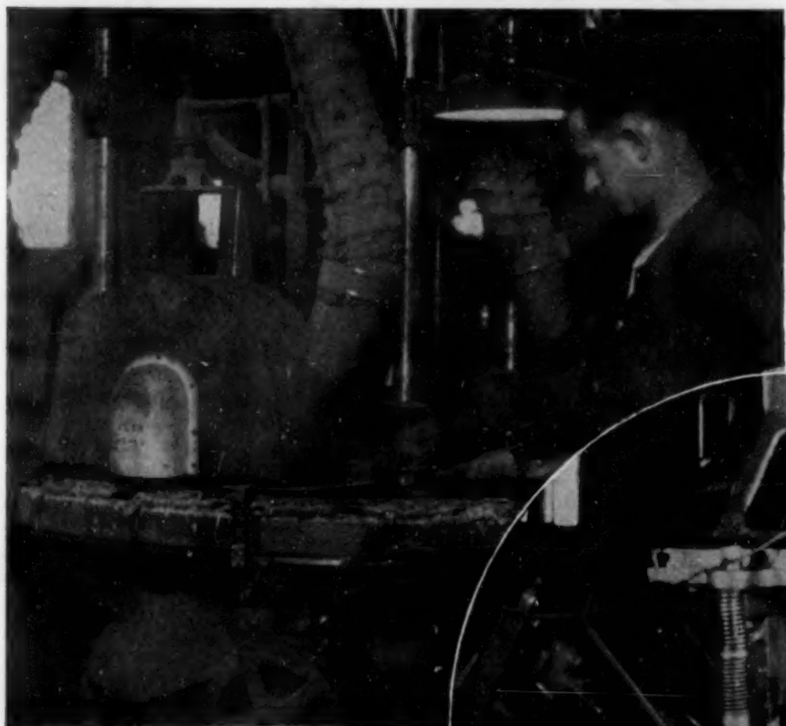
(Continued on Page 269)

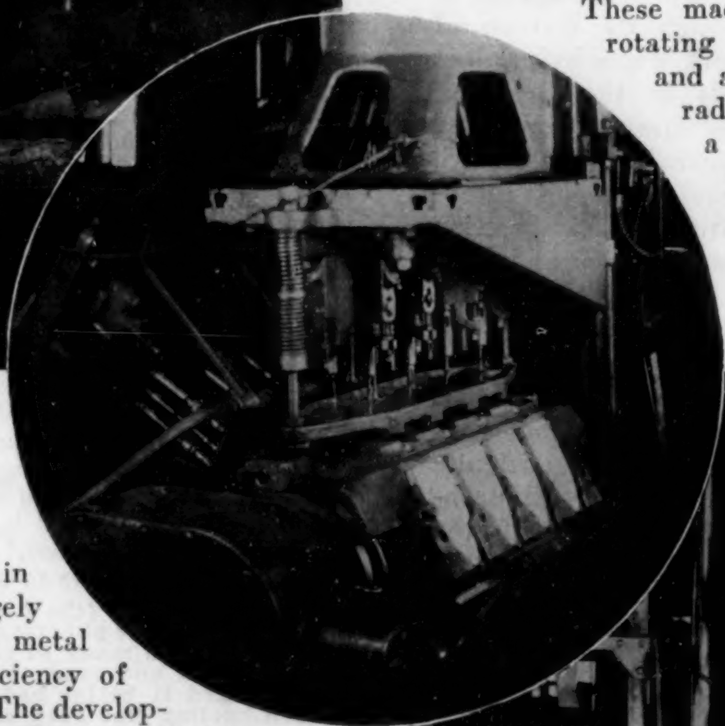
METAL FINISHING

By CLARENCE L.

ORDINARY household irons, although created and devised for strictly useful purposes, are undergoing many changes, and of these changes, style is probably one of the greatest. It seems a far cry from the metal industry to style trends and modes, but the manufacturers have found that women appreciate beauty in irons as well as in clothes and other accessories. Industry in the past has been slow to realize this and the improvements made on the household appliances were, in the main, generally of a scientific nature. An iron was simply an iron—an object of use—and very little concern was given to its appearance.

However, "the old order yieldeth to the new" and now we have beautiful gleaming irons that are a credit to any production put out by manufacturers for practicability





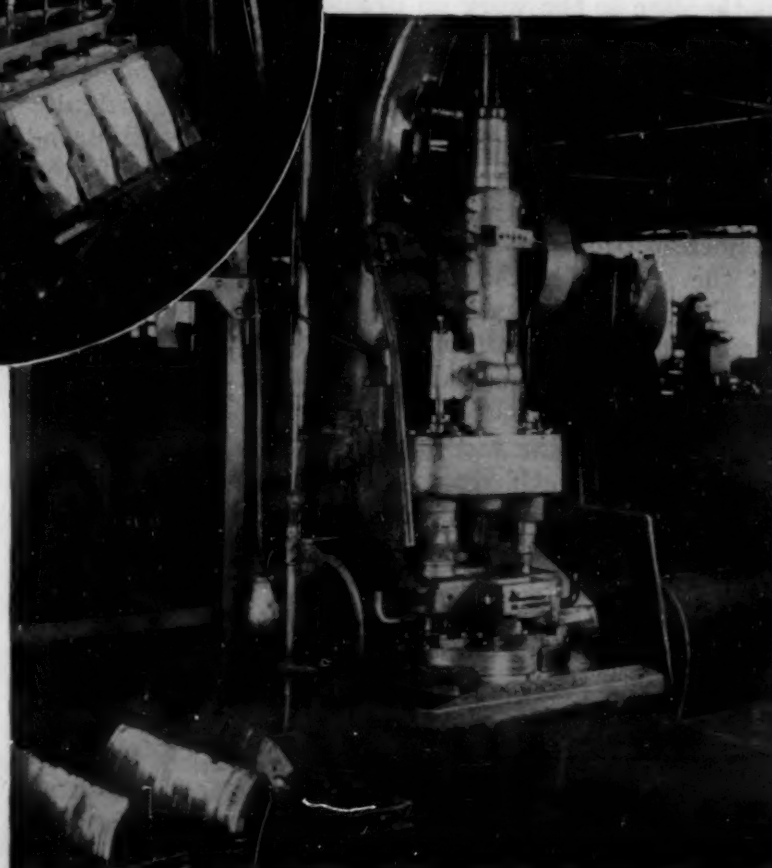


Fig. 1. (above) Four Wheel Automatic Grinding Machine. Fig. 2. (center) Special Drilling & Tapping Machine. Fig. 3. (bottom) Drill & Counter Bore Machine.

as well as beauty. This change in appearance has been made largely by the improved processes in metal finishing and the increased efficiency of automatic finishing equipment. The development of machines and the standardization of processes and material have changed the problem of manufacturing irons from an art to a science with the result that a high quality finish demanded by the public has been reduced to a minimum cost.

The parts requiring finish on the electric iron consist of a cast iron base, a cold rolled steel cover, front and rear handle straps, heel rests, rivets and handle bolts.

The first operation in finishing the iron base is to grind 0.015 inches of material from the top of the base to provide a flat surface for the element and cover on a specially built circular grinding machine. The machine is loaded and unloaded by one operator and the bases pass under four wheels, 9 to 14 inches in diameter, by $5\frac{1}{2}$ inch faces and $1\frac{3}{4}$ inch arbors; one 10 grit, one 24 grit, one 36 grit and one 60 grit. The maximum production of the machine is 30 pieces per minute.

From this operation the bases pass over a conveyor to a special drilling and tapping machine, which drills and taps eight holes at one time and has a maximum capacity of 10 parts per minute. The machine is equipped with a cam operated fixture which is manually loaded and automatically unloaded.

The drilling and tapping operation required considerable development as it was necessary to drill and tap a hole in the iron bases that would have 4 full threads, and not drill through the bases which is less than $\frac{1}{2}$ inch in thickness. High speed steel taps with practically no lead were found satisfactory for the operation. It was necessary for the foundry to reduce their tumbling operations to a minimum to prevent dubbing off of points as this would cause irregular location of bases in the drilling and tapping fixtures. This, in turn, would have made it impossible to automatically grind edges of castings accurately, as the succeeding operations are located from pins that fit in drilled and tapped holes of the iron bases. Next the base is dropped on a belt and is conveyed to tote boxes on gravity conveyor lines which deliver them to a battery of disc grinding machines. These machines are equipped with special rotating fixtures which are cam actuated and are capable of grinding 3 different radii on each side of the iron base at a 58° angle with bases located over pins in drilled and tapped holes. The fixtures also oscillate front to back in order to give even wear on the grinding disc face. The

*Superintendent, Westinghouse Electric and Manufacturing Company, Mansfield, Ohio.

G of ELECTRIC IRONS

L. VAN DERAU*

first 2 grinders are right and left hand and the disc used is 12 grit, 30 inches in diameter, ¼ inch thick, with an 8 inch opening in the center.

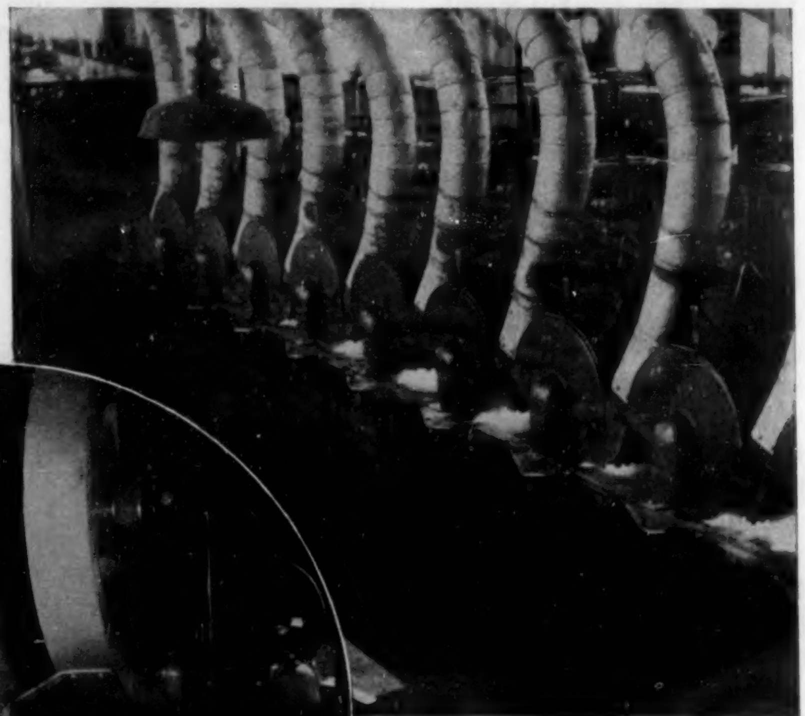
It required a period of almost two years to secure a grinding disc that would grind edges satisfactorily and economically. The first disc used would turn out approximately 500 iron bases, then due to the wearing off of rough surfaces of the disc, and the heat generated, discs would come loose from the steel mounting plate. This was overcome by having the supplier perforate the disc while in the unvitrified state. These perforations had the appearance of a baked waffle and provided space in the disc for iron and abrasive dust. That, in turn, was thrown out by centrifugal force of the rotating disc, after leaving the point of contact of the iron base to the disc, and overcame the abnormal heating of the disc, making it possible to grind from ten to fifteen thousand iron bases on a single disc.

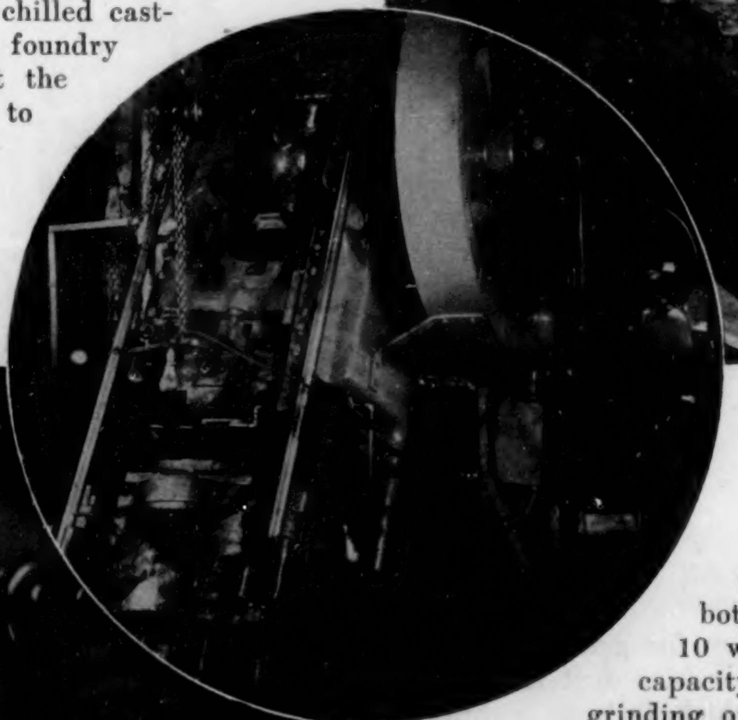
It was also found that it was not practical to grind more than 10 bases per minute as the higher speed would cause small cracks in the edge of iron base, any where from 1/16 to ½ inch in length, that did not show up until the final operation of plating and buffing. These cracks, having the appearance of fine hair lines, were caused by the abnormal heating up of the edge of the iron bases during the grinding operation, and were particularly troublesome on hard chilled castings. It was necessary to have the foundry regulate the time of shaking out the castings from their sand molds to overcome the irregular chilled surfaces of castings. The bases then pass to another right and left hand machine for fine grinding to reduce time of final hand polishing operation on edges. On this machine a 120 grit disc, 30 inches in diameter, ¼ of an inch thick, having an 8 inch center opening is used. Grease stick is used as a polishing lubricant on this disc. The production of these machines is 10 iron bases per minute and from 0.025 to 0.035 inches of iron is removed from the edge on the two grinding operations.

The next operation on the iron base is to grind the back on an 18 inch disc grinding machine which has a special holding fixture. The irons are conveyed from one machine to the other by gravity conveyors throughout all grinding operations. From the grinding operations the base goes to a three station boring machine where the thermostat hole is drilled and counter bored.

The irons are then loaded on a booster and delivered to the loading end of a base bottom grinding machine of the 10 wheel tandem type which has a capacity of 30 pieces per minute. Each grinding or polishing wheel is driven by its own individual motor of from 7½ to 10 horsepower. The pressure and amount of cut of the wheel on the iron base is regulated by spring tension and individual ammeters connected to each motor. The iron bases are loaded on an 8 inch belt equipped with jig attachments and pass under four 10 grit wheels, two 24 grit wheels, two 36 grit wheels and two 60 grit wheels. The wheels are of silicon carbide and bakelite types, and range in size from 14 inches to 9 inches in diameter. They have a 5½ inch face and a 1¾ inch arbor hole. This grinding operation removes from .025 to .035 inches of cast iron from the bottom of the iron bases.

Several thousand dollars was spent in developing grinding and polishing wheels for this machine for grind-





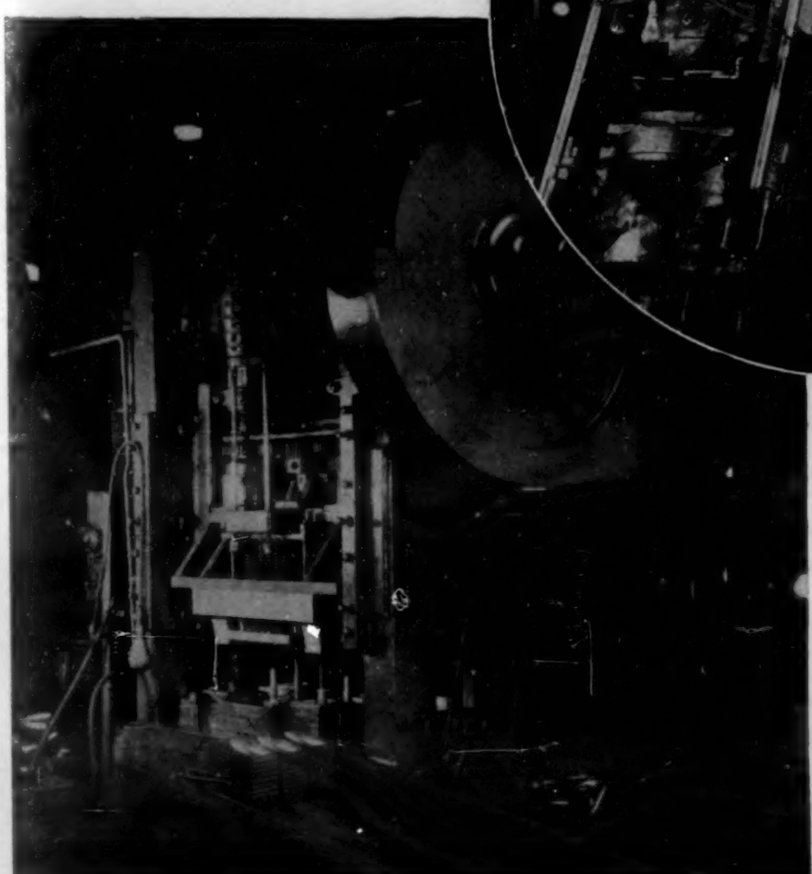
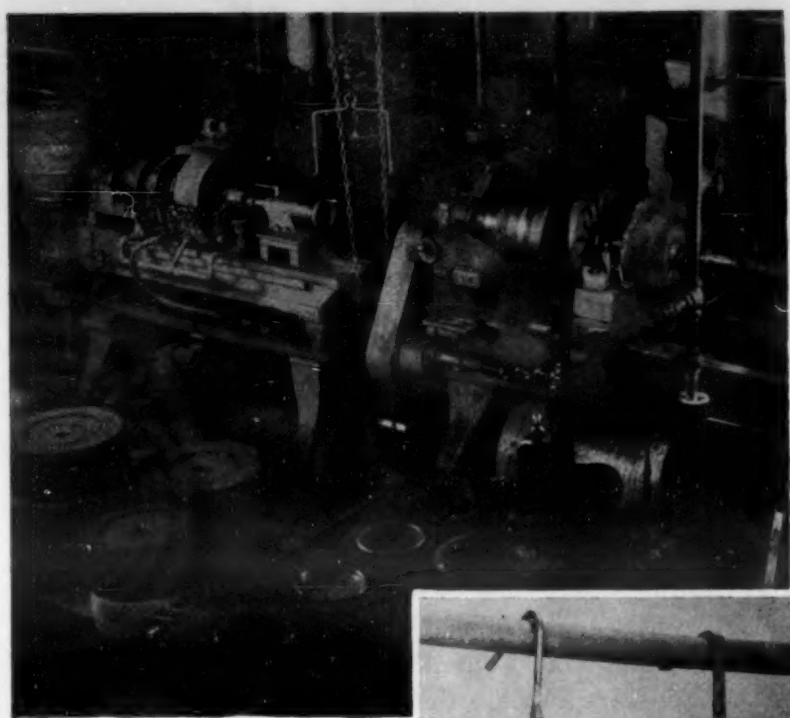


Fig 4. (above) Ten Wheel Polishing Machine. Fig. 5. (center) One Hundred Ton Draw Press. Fig. 6. (bottom) Trimming Press.



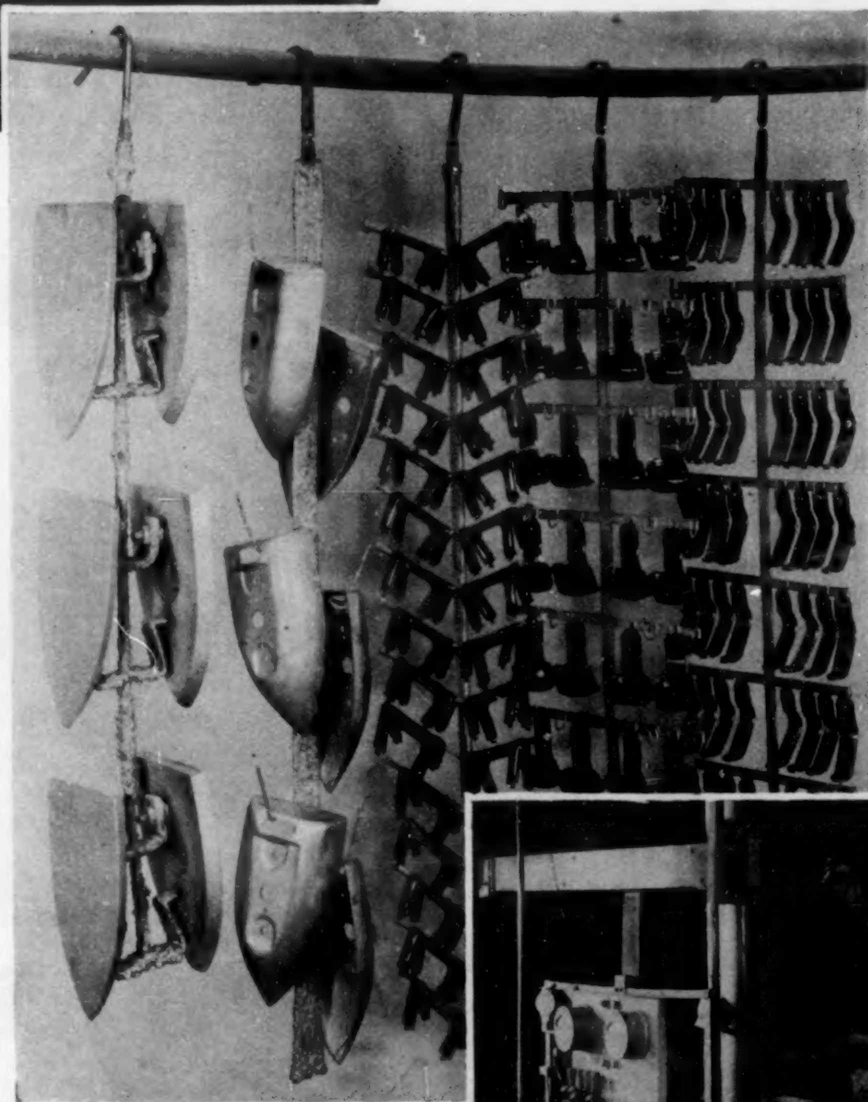
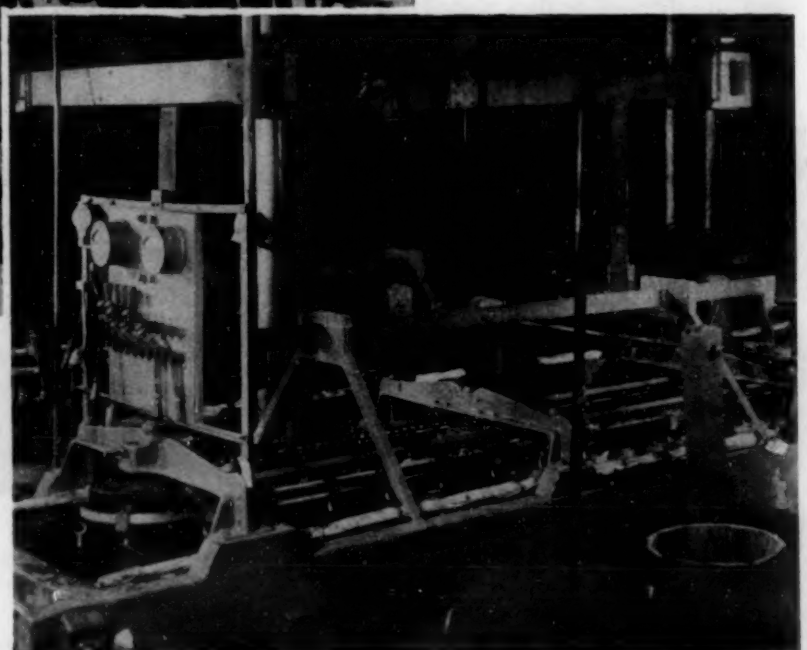


Fig. 7. (above) Truing & Cleaning Machines. Fig 8. (center) Nickel Plating Racks. Fig. 9. (bottom) Nickel Plating Tanks.



ing and polishing iron bases. Machine pressed 10-24 and 36 grit wheels were found very unsatisfactory, and it was necessary for the supplier to make up wheels in which sawdust was mixed with the abrasive and bond and then hand puddled to prevent getting a wheel that was too compact. This type of wheel is very porous after the firing operation, as the sawdust burns out, leaving the wheel in a honeycombed condition; thereby permitting air to circulate through the wheel and overcome the abnormal heating and breaking of grinding wheels. This also overcomes the tendency for grinding wheels to glaze over as the iron and abrasive dust is pressed into the recesses of the wheel, which, in turn, is thrown out by centrifugal force after leaving point of contact of wheel and iron base. The 60 grit Bakelite type of wheel proved far superior to the silicon carbide type of wheel as it left a much finer abrasive mark in the iron casting and did not heat up as much as the silicon carbide type, although it was more expensive.

It was necessary to standardize the grades of the various grit wheels to a range of from K to P of the Norton Company's standard for hardness of wheels. The heating of wheels encountered on this machine are caused by the almost continuous grinding operation; whereas a hand operator is generally off his wheel as much time as he is grinding on the wheel. This idle time permits air cooling of his grinding wheel and is a problem to deal with on almost all continuous automatic grinding machines when using the dry process of grinding.

After the grinding operation the bases are loaded in tote boxes and conveyed around the back of the machine to the loading end. This provides for storage and necessary cooling time between grinding and polishing operations. The wheels are then changed from grinding to compressed canvas polishing wheels which are 16 inches in diameter, $5\frac{1}{2}$ inch face and are set up with emery and glue ranging from 80 grit to 160 grit. Fast cutting artificial grit is used on 80 and 120 grit wheels. The 140 and 160 grits are of the dull cutting Turkish emery, as a fast cutting fine emery required excess buffing to cover wheel marks that would show through in the final buffed iron bases.

Grease stick and 180 grit emery cake are used as polishing compounds. The conveyor belt on the machine is equipped with oscillating fixtures to break up grinding and polishing abrasive marks. After this polishing operation the bases are loaded into tote boxes and conveyed by gravity to the hand polishers who finish the sides and remove sharp edges at the junction of the side and bottom of the base. These operations are performed on compressed canvas wheels set up with 120 to 160 grit emery. The bases are delivered from the hand polishers over gravity conveyors to an inspection station where they are gaged and inspected for defects prior to plating.

Disc type of muslin or canvas polishing wheels were found very unsatisfactory as every ply or section of disc type wheel would show up in the finished iron base, giving the appearance of hills and valleys. It was found

that the compressed canvas type of polishing wheel will remove this defect as the polishing is done on the flat side of the canvas cloth instead of the edges. It was found that the ordinary compressed canvas wheel with side plates on each side, that are commonly used on hand polishing operations or slower types of polishing machines with wheels of smaller width, were not strong enough to stand up in service on this machine, as the wheels would assume a concaved position when in contact with the iron base under the heavy spring pressure, and after leaving the point of contact, it would assume a convexed position, causing the irons to come off the machine with convexed and concaved surfaces. It would also cause the glued segments of the wheel to separate and throw themselves out of the steel retaining plates by centrifugal force. This trouble was overcome by having the supplier of this type of wheel reinforce the center face of the wheel with two additional steel plates. This reinforcement made the wheels cost three times as much, but proved to be more economical as they will last several years in service, against a few hours for the standard type.

The physical and chemical tests for the iron base castings worked to by the foundry are:

Physical

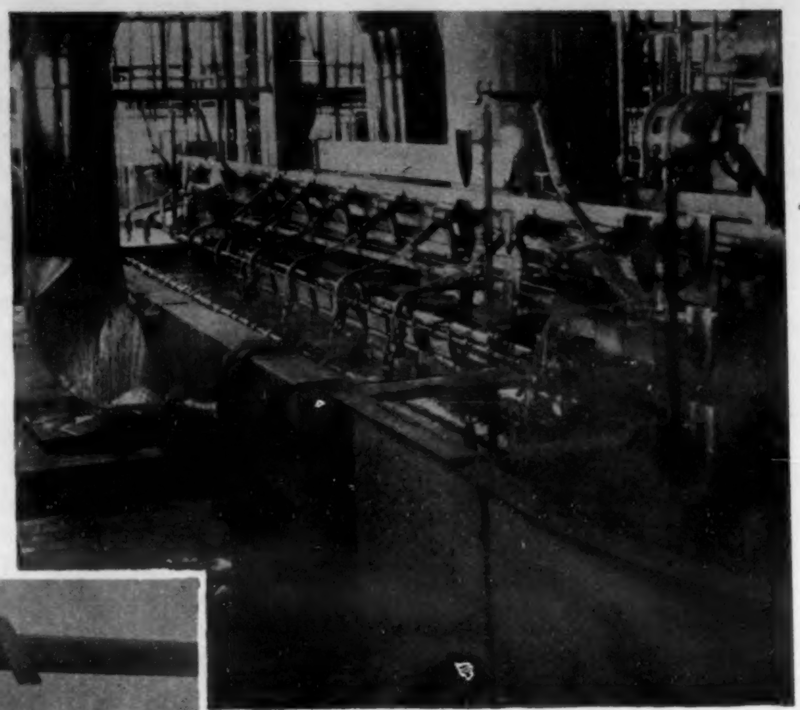
Transverse 2930 lbs. on 1.253" diameter bars

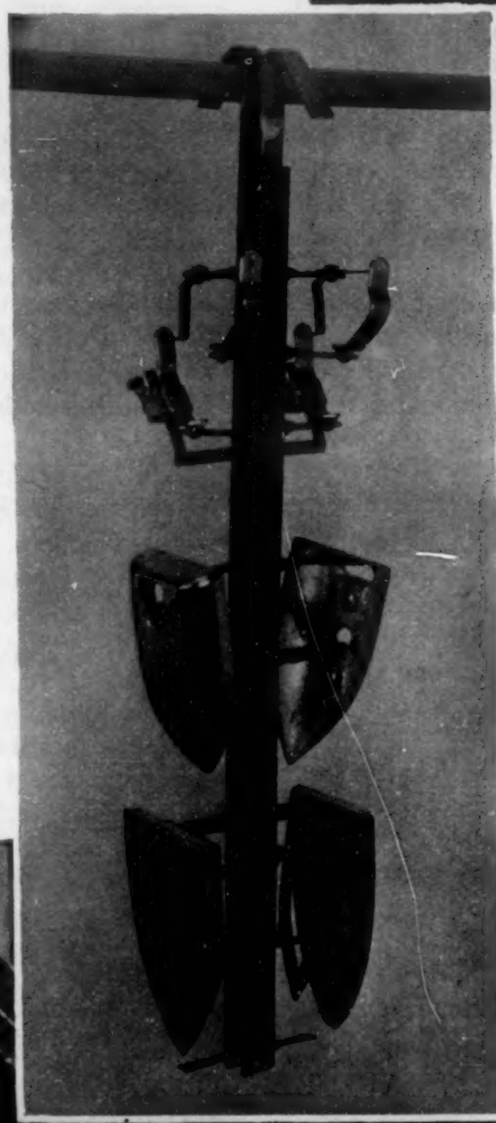
Chemical

Silicon	2.46
Sulphur	.082
Phosphorus	.53
Manganese	.57
Carbon	.48
Graphitic Carbon	3.09
Total Carbon	3.57

The covers which are made of deep drawing, cold rolled steel are of the following physical characteristics:

Olsen .440 - .460
Rockwell B 50 - B 55





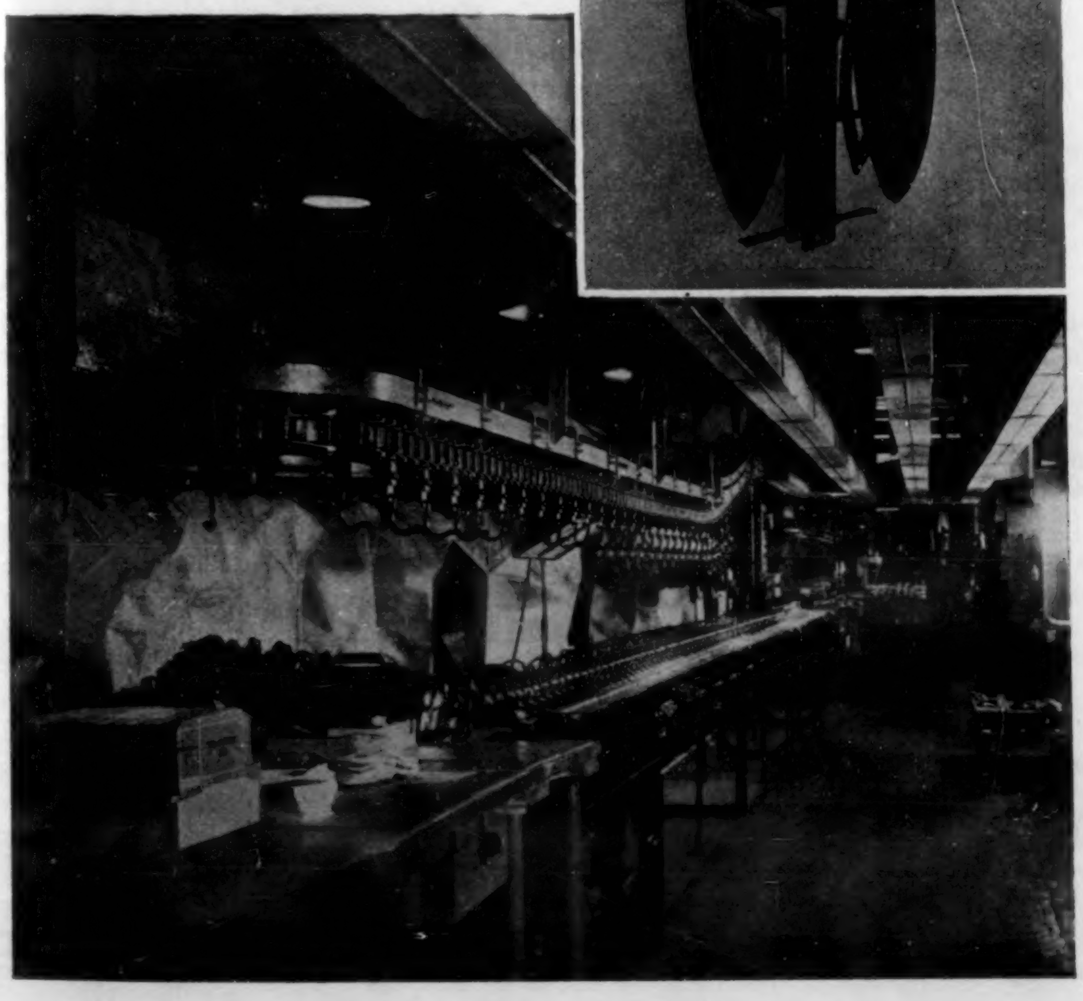


Fig. 10. (above) Automatic Chromium Plating Machine. Fig. 11. (center) Chromium Plating Rack. Fig. 12. (bottom) Iron Assembly Conveyor.

Elongation on 5" long, ¾" wide—
Straight specimen
Longitudinal Minimum 28%
Transverse Minimum 24%

They are first blanked in a die and then formed in a 100 ton draw press. In one operation this press runs at a speed of 20 strokes per minute and is equipped with air cushions and a delivery conveyor belt that takes the covers to the trimming press. The covers are trimmed in a shimmy die. After the trimming operation, handle strap and clamping bolt holes are pierced and heat graduations for the thermostat control are stencilled in a compound die. Then the covers are loaded into tote boxes and delivered by conveyor to hand polishers who polish them on a compressed canvas wheel set up with 160 Turkish emery and glue. They are then brushed on a circular tampico brush using 180 emery cake as a polishing compound in order to remove abrasive scratches. After polishing, the covers are delivered by gravity conveyor to an inspection station where they are inspected for material and polishing defects prior to the plating operation.

As there is always one side of a sheet of cold rolled steel more free from pits and material defects than the other side of the steel, sheets of steel are inspected by the incoming raw material inspector and striped, using a tube approximately 10 inches long, ½ inch in diameter, with a felt cork inserted in lower end and regular cork in top which is filled with a dye solution made up to the following formula:

Lacquer Thinner	75%
Clear Lacquer	15%
Aniline Dye	10%

Various colors indicate the different suppliers, leaving red aniline

color as a mark on questionable steel. This stripe is put on by the incoming raw material inspector by simply drawing his tube of dye from end to end on the selected good side of the steel. This mark indicates to the press operators the proper side to throw blanking burs and makes it possible to always turn the good side of the steel out where the final high finish is required, and has made it possible, with the aid of careful handling in the press shop, to reduce polishing operations from three wheels to one wheel, and has increased production from 30 pieces per hour to approximately 100 pieces per hour in the polishing operation.

All polishing and grinding wheels used in the preceding finishing operations come from a laboratory controlled glue room equipped with special truing and cleaning machines. 80 pounds of high pressure steam and centrifugal force is used to clean off old heads of glue and emery prior to re-setting wheels with glue and emery.

This method of cleaning, dressing and setting up of polishing wheels has proven very economical as very few polishing wheels are worn out by the polishing operation, but are worn out by the polisher using a file or piece of pipe to remove old heads of emery, glue and polishing grease that penetrate into the fabric of wheel. No polisher can clean a wheel using this method without removing some of the fabric and consequently a working face becomes smaller in diameter and goes to the scrap pile prematurely. However, if high pressure steam is not available, the steam cleaning of wheels will not be satisfactory as low pressure steam contains too large an amount of water and will cause the glued segments or plies of cloth to come apart.

A speed of 2200 r.p.m. has proven satisfactory for wheels ranging in size from 10 inches to 16 inches in diameter. The speed should be increased for wheels of smaller diameter in order to throw off glue, emery and greases to prevent penetration into glued sections of wheels.

Wheels cleaned by the above methods will last from five to ten years in service as against a few weeks or months when set up by the polisher.

Glues ranging in price from $.15 to .30 per pound have been tried out on automatic polishing machines and it is more economical to use a high grade hide and sinew glue, as we have found that on the iron bases as high as 16 wheels set up with cheap glue were required; whereas, from three to five wheels were required to do the same given amount of work using the better grade of glue.

The glue is soaked in a definite amount of water (8 lbs. glue to 11 lbs. of water) for approximately 15 hours after which it is heated in a jacketed steam cooker where it is dissolved and flows into a thermostatically controlled steam heated reservoir at a temperature of 180°F. From this reservoir, glue is drawn off into quart containers and placed in a thermostatically controlled hot water table at a temperature of 170°F. Individual cans of glue and brushes are provided for each of the various grades of emery used. The emery containers are steam heated to eliminate the possibility of the glue being chilled by cold emery.

Large wheels used on automatic polishing machines are set up on a wheel setting machine and all wheels are allowed to dry for a period of not less than 12 hours before using. For difficult polishing operations the wheels are dried in an oven at a temperature of 180°F. for a period of at least 12 hours.

Handle straps and heel rests are made of cold rolled steel in cam actuated dies. They are then delivered by conveyor to the plating department where they are burnished in hard maple lined steel burnishing barrels. The barrels are loaded with parts, together with 1/8 inch steel balls and 3 pounds of neutral soap, and burnished for a period of 12 hours.

All of the various parts to be plated, including the polished bases and covers, and the burnished handle straps and heel rests are racked on their respective racks. They are then cleaned in an emulsified soap solution which is as follows:

Tri Sodium Phosphate	1.5 oz.
Caustic Soda	1.5 "
Soda Ash	.9 "
Sodium Metasilicate	.84 "
Bentonite Clay	.06 "
Fatty Acid as Soap	.9 "
Rosin	.3 "
Total	6 Oz.
Water	1 Gallon

then given a water rinse and electro-cleaned in an alkaline copper cleaner of the following formula, using 6 volts, direct current for approximately 1 minute:

Tri Sodium Phosphate	2 oz.
Soda Ash	1.4 "
Caustic Soda	.56 "
Powdered Rosin	.02 "
Bentonite Clay	.02 "
Sodium Cyanide	1 "
Copper Cyanide	.5 "
Water	1 Gal.

and rinsed in water and placed in the moving cathode nickel plating tanks where they are allowed to remain until a deposit of .001 inches of nickel is obtained. (This generally requires 1 hour to 1 hour and 15 minutes of time.)

The current density for nickel plating averages 12 amps./ft.^{2} at $3\frac{1}{2}$ volts. The formula for the nickel solution is:

Nickel Ammonium Sulphate	10 Oz.
Nickel Sulphate	10 "
Sodium Chloride	4 "
Boracic Acid	4 "
Magnesium Sulphate	4 "
Water	1 Gal.

The plating processes are laboratory controlled in order to maintain a soft deposit free from pitting and peeling defects suitable for easy buffing and adherent enough to stand up under stencilling operations that are put on the iron cover in the finished state.

The factors of the nickel solution that require accurate control are:

Factors	*Value*	*Analysis*
Ph	Daily	6.2 to 6.4
Nickel Content	3.56 Oz.	Weekly
Chlorides	3.5 to 4 Oz.	Weekly
Boric Acid	3.5 to 4 Oz.	Weekly
Magnesium Sulphate	4 Oz.	Weekly
Water	1 Gal.	

All plating factors such as current density, plating time and temperatures are standardized and placed on master route sheets and in process specifications that covers the operators activities.

A new nickel solution made to the above formula will have a pH of 5.6 to 5.7 and requires ammonia to raise the pH from 6.2 to 6.4, after which a small addition of 30% Hydrogen Peroxide is used daily to maintain an operating pH of 6.2 to 6.4. By accurate controlling the pH values of the nickel solutions daily, it is possible to practically eliminate all pitting and peeling of nickel deposits. The other factors of a nickel solution are not as sensitive and only require weekly analysis and additions of chemicals to bring them back to their original formulas.

99% rolled depolarized nickel anodes are used as a source for replenishing the metallic nickel content of the plating solutions, and even though the depolarized anodes cost approximately 2¢ more per pound, they have proven themselves to be more economical as it is only necessary to filter the plating solutions twice a year as

against filtering monthly when using the other types of anodes.

This means a saving of approximately $4000 on lost solution and filtering labor on eight 1700 gallon tanks per year in addition to a saving not estimated in excess buffing compounds and labor and rejections that would be caused by floating particles of dirt in the plating solution that would settle out of the solution on all parts that would form a shelf or ledge.

After plating, the racked parts are rinsed in cold and hot water and then placed on an unloading conveyor. The plated polished parts are unracked and placed in tote boxes and sent to the buffing department on gravity conveyors where covers are buffed by hand on buffing lathes running at 3400 r.p.m., using 7 sections of 16 inch diameter, 30 ply, 1/4 inch sewed muslin buffs. These buffs are discarded from the cover buffing operation when they reach a diameter of 10 inches as a peripheral speed changes from 14,200 to 8,700, and these smaller sections of buffs can be used on other lines of apparatus.

Bevelled iron base edges are buffed by hand on one side of a d.c. buffing lathe with a selective r.p.m. speed of 1600 to 2400, while the bottom of another base is being buffed on an oscillating type, automatic buffing machine placed on the other side of the lathe and operated by the edge buffing operator.

A combination of loose and sewed buff sections is used on this operation being of the same diameter and used down to the same size as the buff sections used on iron covers. A lower speed lathe was found more desirable as it overcame the tendency to cut through the iron base edges and produces a superior finish on the bottom of the base.

Lime buffing compound is used for buffing and coloring of nickel. The buffed parts are inspected, packed in tote boxes and sent by gravity conveyor to the chromium plating machine. The handle straps and heel rests are unracked and placed in burnishing barrels where they are burnished for one hour to bring out a luster of the nickel. These parts are then sent to the chromium plating machine.

All parts are racked on special racks for chromium plating and are plated on an automatic chromium plating machine. The machine consists of a rotary conveyor with cam operated lifts through a series of tanks. The loading and unloading of the machine takes place at one station requiring one operator.

Parts travel through an alkaline electro cleaner operated at room temperature, a water shower and rinse, and another water shower before entering the chromium solution. After a 3 minute chromium plating period and 2 successive water rinses and a final cold water spray, parts pass through a hot air drying tunnel for approximately 3 minutes. The final rinsing of parts through a cold water shower overcomes water stains on the plated parts.

The parts are then unracked, inspected, packed in tote boxes and dispatched by conveyor to the assembly conveyor.

The cleaner used for chromium plating is of the following formula:

Sodium Metasilicate	2 oz.
Water	1 Gal.

The reason it is run at room temperature is to prevent staining of clean parts when passing out of the electro cleaner into the first water shower, due to the iron base castings absorbing heat, causing the cleaner to dry off during time of transfer.

The formula for chromium solution is:

Chromic Acid	40 oz.
Sulphuric Acid	.40 oz.
Water	1 Gal.

The operating temperature is 135°F. and the current density is approximately 300 amps./ft.^{2} The chromic acid and sulphuric acid content is checked weekly by the chemical laboratory and additions of these 2 ingredients are always governed by chemical analysis.

Iron elements, cords and thermostats are made in their respective detailed assembly groups, feeding up to the main assembly conveyor where they join up with the plated parts for assembly. After assembly they are given a heat test, after which they pass through a cooling tunnel. Irons are removed from the cooling tunnel conveyor and receive a final buffing operation on loose cotton buffs to remove all stains and marks due to handling. After this operation they are placed in their respective cartons and delivered by conveyor to the warehouse.

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Readers' Comments, continued from page 263

The fact, however, that minute particles of diamond are probably harder than similar particles of the carbide can hardly be advanced as an argument favoring the precipitation and dispersion of diamond particles rather than of carbide particles in quenching. The hardness resulting from submicroscopic precipitation is not dependent upon the hardness of the precipitant as much as it is upon the fact that by their location and number the precipitated particles effectively interfere with slip.

Admitting the possible formation in the quenching bath of minute diamond particles, are the arguments offered by Mr. Allen sufficiently convincing for the ready acceptance of his theory?

He conceives the possible existence of 3 steps in the formation of the carbide Fe_3C, namely the formation of the diamond phase as the carbon is rejected from the γ solid solution, the transformation of the diamond phase into the graphite (or amorphous) phase and finally the formation of the carbide.

It is interesting to recall that Percy in his great work "Iron and Steel," published in 1864, refers to the possible existence of graphite in quenched steel when he writes:

> In molten, or even in strongly heated solid steel, the carbon is wholly combined, or, possibly, simply dissolved; and by sudden solidification of the metal in the one case, or sudden cooling of it in the other, the whole of the carbon remains diffused through the mass. However, the carbon may have separated notwithstanding, and exist in a state of infinitesimally fine division; and it is conceivable that it may be in the allotropic condition of graphite, and may yet, owing to what I will venture to designate an atomic state of disaggregation, be capable of entering into combination with nascent hydrogen, and what is termed *combined* carbon. Whether this view be correct or not, it is certain that hard and soft steel differ essentially with regard to the mode of existence of the carbon in a mass.

Parenthetically, may we not express our admiration that at so early a date many of the assumptions upon which modern theories are based were familiar to Percy, namely the existence of carbon in a combined and dissolved form (an early conception of solid solutions), the retention by sudden cooling of carbon in a diffused condition and the existence of tensions or stresses in quickly cooled steel.

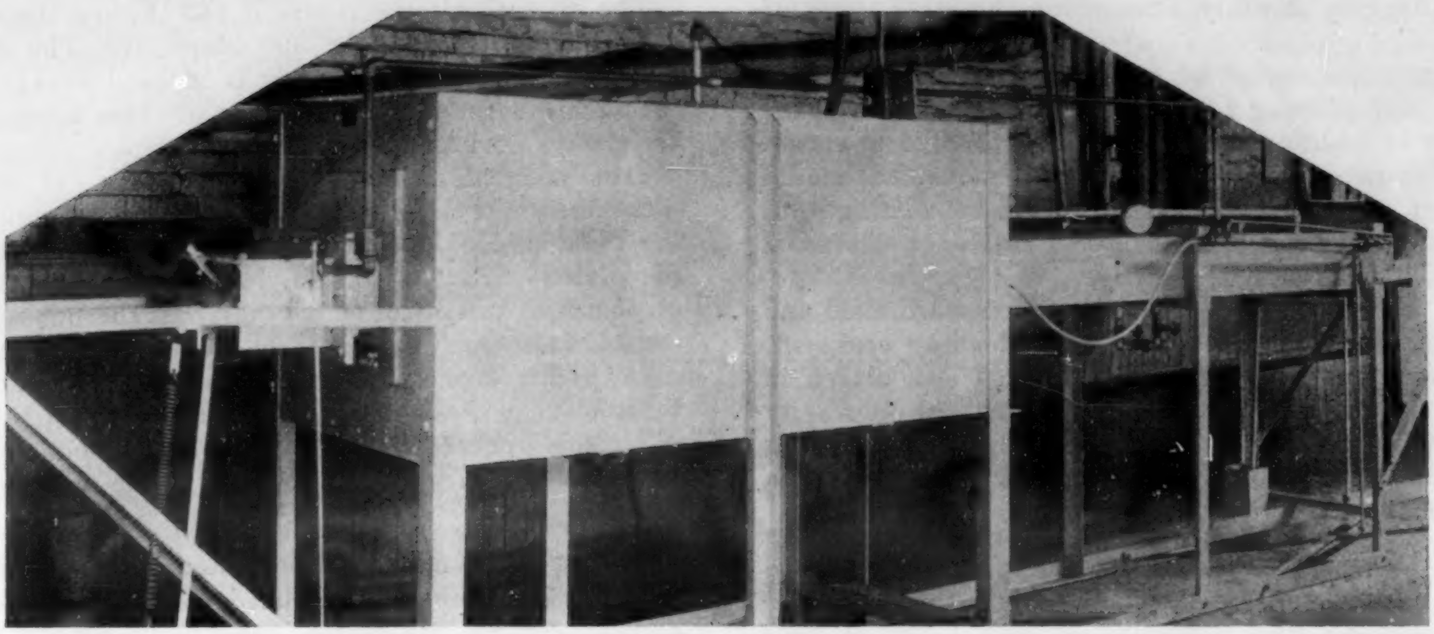
Mr. Allen's theory is certainly not so simple as the one based solely upon carbide precipitation and unless there are good reasons for abandoning a simple theory in favor of a more complex one, we should not readily do so—we may ask whether the reasons offered by Mr. Allen are sufficiently good.

If submicroscopic diamonds are present in hardened steel, should not their existence be revealed by X-ray diffraction analysis? If particles of diamond and of graphite are present in hardened steel, should not the solution of the steel in boiling nitric acid leave a carbonaceous residue? As to white and dark martensite, might it not be that the latter represents the first step in the formation of carbide particles of microscopic size and possibly for that reason more readily attacked by some etching reagents. It would then be a connecting link between true (white) martensite and troostite.

In regard to Mr. Allen's contention that his theory "fits in with the view that on slow cooling austenite decomposes directly to pearlite," I have on several occasions attempted to explain why I do not believe such view to be correct, and I shall again do so later in this article.

To sum up briefly the theory of the constitution of steel, I have ventured to offer: rapid and intense precipitation of submicroscopic particles of carbide of iron takes place in the quenching bath at some 300°C. when γ-iron transforms into α-iron. This may be described as nearly instantaneous and

(Continued on Page 280)



Heat Treating Furnace Atmospheres

By SAM TOUR*

Classification of Furnaces:

FURNACES can be classified according to the motion of the atmosphere within the heating chamber as follows:

I. Transient or rapidly moving atmospheres.
   a. Gas-fired furnaces of the hearth or oven type.
   b. Oil-fired furnaces of the hearth or oven type.
   c. Coal-fired furnaces of the hearth or oven type.
   d. Wood-fired furnaces of the hearth or oven type.

II. Quiescent or very slowly moving atmospheres in the work chamber.
   a. Electrically heated furnaces,
      1. Metallic resistor,
      2. Globar resistor,
      3. Carbon plate resistor.
   b. Fuel-fired retort furnaces of the pot, box, assay muffle or closed heating chamber type.

Transient Atmosphere Furnaces:

In the transient atmosphere type of furnace, the atmosphere surrounding the work in the furnace is dependent upon the method by which the furnace is fired. For this reason, the atmosphere around the work cannot be controlled independently of temperature. Every time the ratio of fuel to air being burned is varied, in attempts to control the furnace atmosphere, the thermal efficiency of the fuel combustion is affected. For good efficient combustion of fuel and, therefore, economic and efficient operation of the furnace, the atmosphere within the furnace cannot be widely varied. There are certain limits to the atmosphere which can be obtained in a furnace of this type even though one is to sacrifice efficient combustion.

In a majority of the fuel-fired heat-treating furnaces in use today, combustion is not entirely complete in the combustion chamber. This is especially true when operating with a so-called "neutral atmosphere." In these cases, combustion takes place not only in the combustion chamber, if such a chamber has been incorporated in the furnace when it was constructed, but also in the heating chamber as is evident by the flames seen in this chamber. If flames are present in the heating chamber, combustion is taking place there and obviously combustion has not been complete in the combustion chamber. Also, obviously, if combustion is taking place in the heating chamber, although a soft flame surrounds the work, oxygen is present or combustion would not be supported. The work is, therefore, exposed, when surrounded by a soft flame, to a mixture of air and the combustible gases of the fuel.

Gas analyses made upon quickly cooled gas samples withdrawn from such furnaces in the neighborhood of the work being treated often show oxygen, hydrogen, carbon monoxide and carbon dioxide all present at the same time. Evidently the gases of the atmosphere are not in equilibrium with each other and combustion is proceeding in an attempt to arrive at this equilibrium condition in the gases for the particular temperature.

It is important to consider these combustion reactions which are taking place. In these reactions, nascent or atomic gases are continually being released. Nascent or atomic gases are many times more active than molecular gases and in that state tend to react much more rapidly with the work being heated. These gases tend to cause the work being heated to scale or corrode or carburize or decarburize or be changed in any one or several of these ways.

The atmosphere existing in a transient atmosphere type of furnace is a function of the quantity of air being supplied for the combustion of the fuel. It can be subdivided for consideration into three classes as follows:

1. Insufficient air. Where a very great insufficiency of air is supplied, the fuel tends to crack and deposit carbon and liberate hydrogen. In spite of the carbon deposition on the work, it is often found that the steel will decarburize in such atmospheres. This can be attributed to the very active decarburizing action of hydrogen in moist atmospheres. Under these conditions, steel very seldom scales.
2. Intermediate air supply. Sufficient air supplied to react with all of the carbon in the fuel and the hydrogen in the fuel but not sufficient to burn all of the carbon to carbon dioxide. In this type of atmosphere, there are present, after the reactions are complete, carbon dioxide, carbon monoxide, water vapor and nitrogen. Such an atmosphere may or may not carburize, decarburize or scale steel entirely dependent upon the kind of steel being heat-treated and the temperature of operation.
3. Excess air supply. Here more than sufficient air is supplied to burn all of the carbon in the fuel to carbon dioxide and all of the hydrogen to water vapor. When combustion reactions are complete, the furnace atmosphere consists of surplus unused oxygen, carbon dioxide, water vapor and nitrogen. Such an atmosphere may or may not decarburize or scale steels depending upon the amount of oxygen present, the kind of steel and the temperature of operation.

The important thing to bear in mind in connection with transient atmosphere types of furnaces, however, is that the atmosphere consists to a considerable extent of moist reacting gases which react not only between each other but also with the surface of the steel.

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Quiescent Atmosphere Furnaces:

In quiescent atmosphere furnaces, the atmosphere is entirely independent of the heat input into the furnace and so can be controlled to a much greater degree than in furnaces of the fuel-fired type with transient atmospheres. The atmosphere is controlled by the admittance or introduction into the heating chamber or across the door or otherwise of various gases or gas mixtures and of various reagents.

Quiescent atmosphere furnaces can be classified according to the atmospheres in them somewhat as follows:

1. Air—20% Oxygen 80% Nitrogen (approx.).
2. Combusted fuel gases.
3. Raw fuel gases.
4. Cracked gases such as "electrolene"—methane plus carbon monoxide plus hydrogen plus nitrogen plus water vapor.
5. Ammonia—Nitriding Furnaces.
6. Nitrogen + Hydrogen — dissociated ammonia.
7. Hydrogen.
8. Vapors of Liquid—
   a. Steam,
   b. Oil,
   c. Methanol.

To cover all of these classes of quiescent atmosphere furnaces in one paper is too large a field so that the balance of this paper will be restricted to a discussion of the class No. 2 indicated above, the combusted fuel gas class of quiescent atmosphere.

Combusted Fuel Gas Atmosphere:

By "combusted fuel gas" is meant a gas mixture resulting from burning of gas and air properly proportioned so that any desired condition can be obtained. Such combusted gases are stable in themselves since they are the products of the reaction of combustion leading towards equilibrium. Such gas atmospheres are, therefore, in themselves free of reacting gases or nascent gases.

A combusted fuel gas, or in other words the product of combustion of a fuel gas (fuel gases, of course, being considered as hydro-carbon gases), is a mixture of the following:

Nitrogen—introduced mainly with the air used for combustion.

Water Vapor—resulting from the burning of the hydrogen of the hydro-carbon gas with the oxygen of the air to water.

Oxygen—if an excess of air has been used for combustion.

Carbon monoxide—if a deficiency of air has been used for combustion.

Carbon dioxide—resulting from the burning of the carbon of the hydro-carbon gas with the oxygen of the air.

Moisture or water vapor in furnace atmospheres is a very important factor not only insofar as it affects the steel in itself, but insofar as it affects the gas reaction. Perfectly dry gases are quite inactive insofar as reacting with each other is concerned and also insofar as reacting with metals is concerned. Perfectly dry gases are very rare. Jominy[1] has shown that perfectly dry hydrogen, for example, is neutral towards steel up to temperatures as high as 1600° or 1700° F., but that if it contains as little as .1% of water vapor, it becomes a very active decarburizer towards steel even as low as 1200° or 1300° F. Guthrie[2] has shown that perfectly dry raw gas is a very poor carburizer for steel, but that, if a small and controlled percentage of water vapor is introduced, it becomes an active carburizer. Moisture is, therefore, not only of importance insofar as it affects gas reaction leading towards equilibrium condition in the gas atmospheres, but also insofar as it affects the reactions which take place between the gases and steel in the furnace.

Combusted gases which are stable against one another at a given furnace temperature, may easily not be stable towards steel at that temperature and the presence of water vapor will accelerate the steel-gas reaction. If the combusted gases are not stable against one another at the particular temperature at which the furnace is operating, they will react among themselves and in this reaction, which is accelerated by the presence of water vapor, they will develop certain quantities of nascent gases which in turn will be more active towards work in the furnace.

In addition to water vapor acting as a catalyst for many of the reactions between the gases in furnaces, we must also consider that iron itself is apparently a catalyst for many of these reactions and as such causes a greater activity of reaction at the surface of the steel than elsewhere in the furnace. This means that the quantity or concentration of nascent gases at the surface of the steel is greater than elsewhere and, therefore, the effect of such gases upon the steel is accelerated. The steel scales, corrodes, carburizes, decarburizes, nitrides, etc. according to what the gases are and the rate at which they are supplied to the surface of the steel and the rate at which they react at such surfaces.

Neutral Atmospheres:

The question naturally arises as to what really constitutes a neutral atmosphere in steel treating work. General acceptance is that carbon dioxide is oxidizing,

[1] *Engineering Research Bulletin* No. 18, March 1931, *Department of Engineering Research, University of Michigan.*

[2] R. G. Guthrie & O. Wazasek. *Transactions American Society for Steel Treating,* Vol. 12, 1927, page 853.

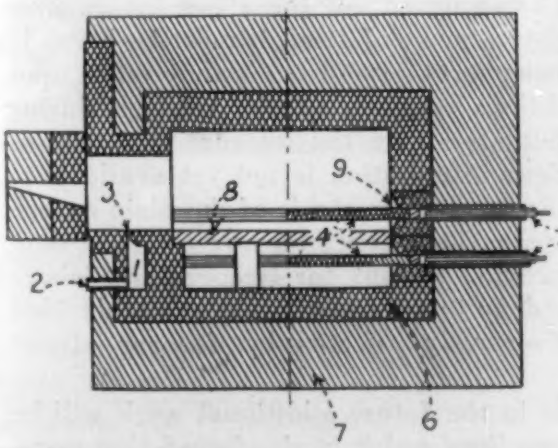


Fig. 1. Diagram of "Certain Curtain" Atmosphere Control

1. Atmosphere combustion chamber.
2. Inlet from Manometer
3. Slot emitting curtain of combusted gases
4. Globar Heating Elements
5. Water cooled terminals
6. Refractory lining
7. Heat insulation
8. Hearth plate
9. Terminal bricks

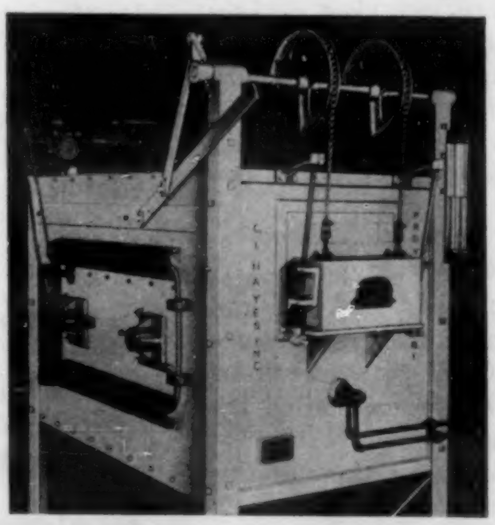


Fig. 2. Manometers as shown in upper right hand corner.

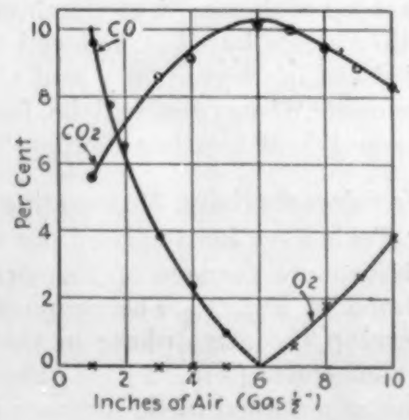


Fig. 3. Typical Atmospheres for various settings of air and gas valve at 2400° F.

oxygen is oxidizing, water vapor is oxidizing, carbon monoxide is reducing, nitrogen is neutral, and hydrogen is reducing. Unburned hydro-carbons, of course, are considered as reducing. If these things are correct, then the amount of reducing gases present should be sufficient to neutralize or balance the oxidizing gases present in order that a neutral atmosphere can be obtained. In the combusted fuel gas types of furnaces, if carbon dioxide is present to any degree, it is generally found that no hydrogen and certainly no hydro-carbons are present, therefore, we need to consider only the balance between carbon monoxide and the carbon dioxide and water vapor or free oxygen. Carbon monoxide and free oxygen both are not present at the same time in a stable combusted fuel gas atmosphere so that we need only balance the amount of carbon monoxide against the carbon dioxide and water vapor.

The above apparently logical assumption, however, with regard to the relationship between various gases in steel is not quite a true picture. It surprisingly has been found that for some steels at temperatures around 1500° F., for example, an apparent neutral atmosphere contains no carbon monoxide at all, but some free oxygen, carbon dioxide and water vapor. If the assumptions that these three are all oxidizing are true, then such an atmosphere would not be considered as neutral. What then is a neutral atmosphere?

The writer proposes that the definition of a neutral atmosphere be freed from any reference to the composition of that atmosphere and be left to mean "an atmosphere which does not react with the material in question at the temperature in question."

An atmosphere neutral towards an oil hardening tool steel need not be, and in fact is not, neutral towards a stainless steel. A consideration of the neutrality of various atmospheres for the heat-treating of steel thus leads us to a consideration of the material being heated in the furnace. Even though the steel comes out of the furnace often apparently free of scale, if it has a soft skin due to decarburization, the atmosphere was not neutral. This was clearly shown by J. J. Curran and G. H. G. Williams.[3]

Decarburization or soft skin is a common occurrence with oil hardening non-shrinking tool steels and with chromium bearing steels especially. It is also common with high speed steel and with aluminum bearing steel such as used for nitriding. It has been claimed by some that soft skin can be eliminated by the use of very high carbon monoxide content in the atmosphere, but there is some doubt as to whether or not their claims have been proven. Soft skin in oil hardening non-shrinking tool steels and carbon tool steels can be eliminated by the use of a combusted fuel gas atmosphere carrying certain percentages of free oxygen. Definite information is still lacking with regard to aluminum bearing steels and many other steels but it is believed that the differences are in matters of degree only and that in these steels certain amounts of oxygen will be found to be required at the normal heat-treating temperatures.

Non-decarburizing Non-scaling Atmospheres:

Tests have been carried out with a combusted fuel gas atmosphere furnace of the certain curtain type as illustrated in Fig. 1. The proportion of gas to air used to develop the atmosphere in the furnace is controlled by manometers (Fig. 2). Curve showing typical atmospheres obtained in the furnace for various settings of the air and gas valve with the furnace operating at 2400° F. are shown in Fig. 3. Plain carbon tool steel was heated to regular quenching temperatures in a furnace of this nature and various furnace atmospheres experimented with. Furnace atmospheres were determined by means of Orsat analyses made upon samples of the gas withdrawn through a nickel tube inserted to about the center of the furnace. Samples were withdrawn only after the furnace had been operating on one setting of the valves long enough so that we were reasonably certain that equilibrium conditions had been arrived at in the body of the furnace. Tests were carried out on carbon tool steel with atmospheres varying all the way from air containing 18-20% of oxygen to a combusted gas atmosphere containing some 12% of carbon monoxide. With the high oxygen concentrations as in air, considerable scaling developed and with high carbon monoxide concentrations soft skin developed. With oxygen content of around 4%, it was found that at a temperature of 1500° F. practically no scale formed and no decarburization resulted on plain carbon tool steel. This was tried out on oil hardening non-shrinking tool steels and similar results obtained. At 1600° F. apparently around 2.5% of oxygen present in the combusted fuel gas atmosphere is indicative of an atmosphere which is fairly neutral to plain carbon steels and chrome-vanadium steels.

At temperatures of 1800° F., the only real work carried out to date has been with stainless steel and indications are that a fairly neutral atmosphere at this temperature for stainless steel is one containing from 8-10% of free oxygen. Work on the pre-heating of high speed steel of the 18-4-1 type at temperatures around 1600° F. indicates that decarburization will result unless from 2-3% of oxygen is maintained in the atmosphere. This percentage of oxygen causes no scaling on high speed steel at this temperature. At temperatures of 2300° F. again with 18-4-1 high speed steel, scaling and decarburization results apparently from the presence of any free oxygen, and from 1-2% of carbon monoxide is required to obtain neutrality. At 2360° F. again with high speed steel of the 18-4-1 type, some 5% of carbon monoxide is required for neutrality, and at 2400°F. fully 10% is necessary. Experimental work has not been carried out on cobalt bearing high speed steels to a sufficient degree to determine what is a proper atmosphere for the same if one can be found. To date results have indicated that this steel is very liable to serious soft skin.

From the above information, it is evident that as temperatures are increased the oxygen present in the atmosphere must be reduced until it has reached zero and then carbon monoxide must be increased until at higher temperatures considerable carbon monoxide is necessary.

In attempting to apply any of the above information to the actual heat-treatment of steel, it must be borne in mind that gas atmospheres not only have their effect upon the surface conditions of steel in the furnace during heat-treatment, but also upon the internal structure of that steel. Sufficient information is not yet available to state just what effect is had on steels of the plain carbon tool steel type or for that matter on any steels at temperatures below 2000° F., but for temperatures above 2000° F. fairly definite information is available that grain growth is seriously affected by furnace atmospheres.

It is hoped that in the future additional work will be possible along these lines and it is also hoped that many others will become interested in this work and will publish their results so that eventually a fuller and more complete picture will be available of the effect of furnace atmospheres not only upon the surface, but upon the structure of steel and other metals.

[3]Decarburization of High Carbon Steel in Reducing Atmospheres. *Transactions American Society for Steel Treating,* Vol. 14, 1928, page 809.

Sintered Tungsten Carbide Brinell Balls

By HAAKON STYRI *

THE BRINELL test is the most universally used method for hardness testing because of its convenience and reliability. When using the ordinary Brinell ball, however, it is not satisfactory for material of greater hardness than about 600 Brinell, on account of the large permanent deformation of the ball at the contact point.

Of the many efforts to increase the hardness of the ball, the best known is the work hardening of the ball, introduced by Hultgren.[1] With this ball it is possible to reproduce results within 1% up to 650 Brinell with certain precautions that will be discussed later. A careful study on iron-carbon-vanadium Brinell balls was published[2] by Quick and Jordan, indicating some improvements on the work hardened Hultgren ball.

Attempts have previously been made to produce tungsten carbide balls in order to use the Brinell method for measuring greater hardness and some foreign made tungsten carbide balls have been obtainable on the market. Recently, satisfactory and accurate tungsten carbide balls have been produced in the United States through the coöperation of the Carboloy Company and the Atlas Ball Company. The rough ball blanks with diameter and sphericity variations of several thousandths of an inch, are furnished by the Carboloy Company, Inc. The Atlas Ball Company has developed a grinding method whereby these extremely hard, rough blanks are ground to within an accuracy for diameter and sphericity of better than 0.000025".

It has been, of course, of particular interest to compare the relationships between Brinell numbers obtained with this new Carboloy ball and Brinell numbers obtained with the Hultgren ball, with the Rockwell diamond cone numbers and the Vickers pyramid numbers obtained on the same materials. For test purposes 8 disks ½" thick of 1% C and 1.5% Cr were cut from the same bar, quenched in brine from 850°C. and tempered at different temperatures as shown in the table. In addition a specimen of tantalum carbide (G77B - Carboloy) was used.

After fine surface grinding and papering of the specimens one impression was made with a 5 mm. Hultgren ball. The diameter was measured and estimated to the nearest 0.01 mm. with a Bausch & Lomb microscope and the permanent deformation of the ball measured with an optimeter and estimated to the nearest 0.00001". All the readings were made by 2 independent observers and did not differ more than these amounts. After the first impression the same spot on the ball was used for 10 more impressions, which all proved to be very much alike and did not increase noticeably for the later readings even for the hardest steel discs. The 11 readings were therefore averaged and the total permanent deformation after the 11th impression was again measured. A new ball was used for each disk.

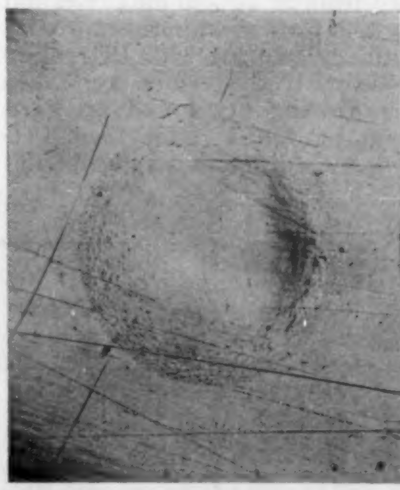
The Hultgren balls which had been used on disks 4 and 5 were then used with the same contact point on disks 1, 2 and 3 and the Brinell hardness obtained. It will be noticed that these Brinell readings are lower than the previous readings made with balls that had not been used on the hard material. On the other hand the deformation of the ball in the first test on the hard material of disk 4 and 5 is so large that later impressions on the same hard material are not materially affected.

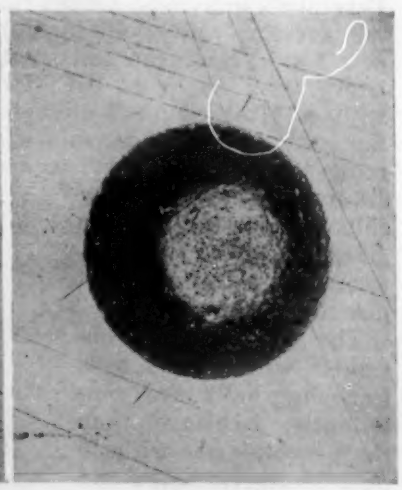
Similar tests were made with 5 mm. Carboloy balls, and in addition also with the Carboloy ball which had been used for 100 impressions on disk 5. All impressions read within 1% difference in diameter. The permanent deformation of the Carboloy ball was 0.009 mm. (0.00036") after 11 impressions on disk 5, and increased to 0.012 mm. (0.00048") after 100 impressions. The Brinell hardness obtained on disks 1, 2 and 3 with this Carboloy ball in the same position shows that there was practically no effect from 100 impressions at 780 Brinell on the observed diameter of impression on the softer disks.

The impressions made with Carboloy balls are much easier to read in the microscope than impressions made with the Hultgren balls, particularly on harder material, as shown in the illustrations of impressions on disk 5.

The Rockwell hardness of the steel disks was measured as an average of 10 impressions and of the tantalum carbide (G77B) as an average of 3 impressions. The Rockwell machine was standardized against a Rockwell C standard sample of 66 to 67 R.C. 150 kg. The value used was 66.4 R.C.

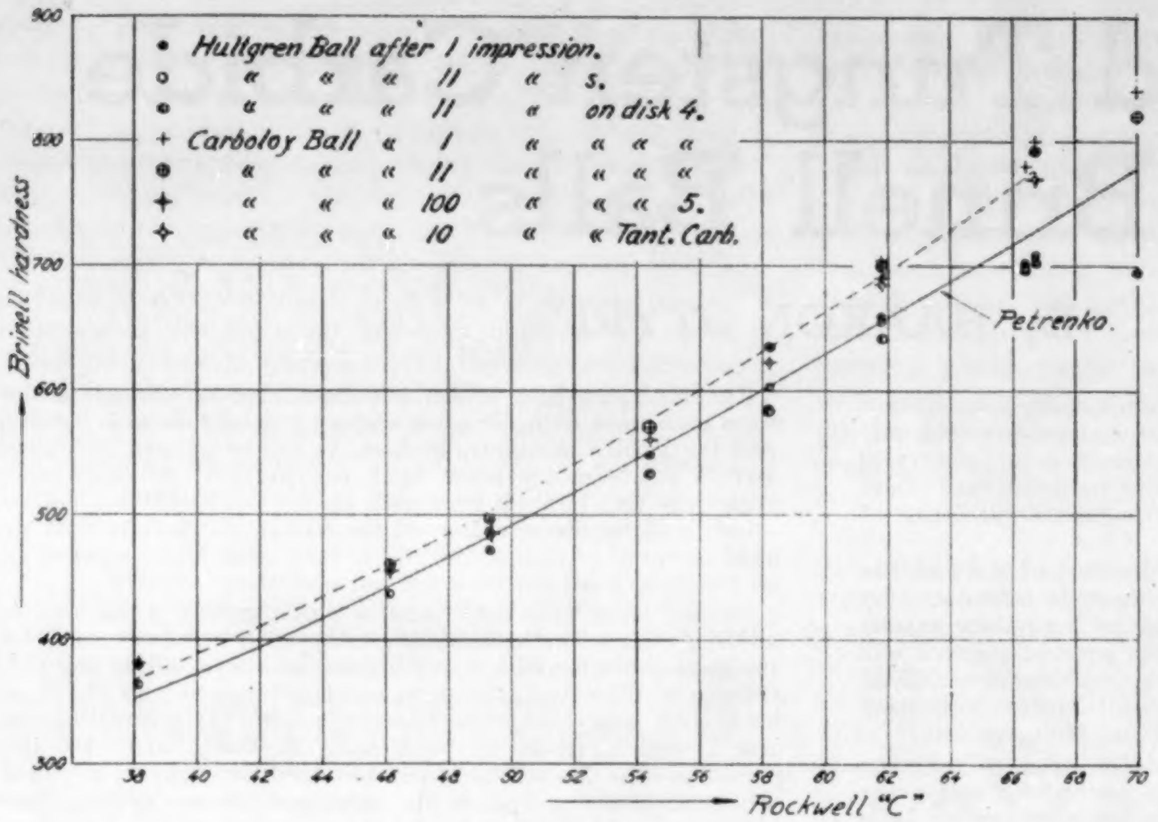
The Hultgren ball failed absolutely on the tantalum carbide, giving a greater diameter of impression than for disk 4 due to flattening, and the impression was difficult to read, while the first impression of the Carboloy ball was easy to read and gave


Hultgren on Disk 5


Atlas Carboloy on Disk 5

*Director of Research, SKF Industries, Inc.
[1] *Proceedings American Society for Testing Materials,* Vol. 24, II, 1924, page 304.
[2] *Transactions American Society for Steel Treating,* Vol. 12, 1927, page 3.

Disk number	6	7	1	2	8	3	4	5	Tantalum Carbide
Tempered at—°C.	550	490	425	350		170	n.t.	n.t.	
Vickers P.N.—30 kg. load (av. of 4)	392	480	520	595	675	758	910	900	1110
Rockwell "C" 150 kg. load (av. of 10)	38.1	46.1	49.3	54.4	58.2	61.8	66.7	66.4	70
5mm. *Hultgren Ball.* 750 Kg. load.									
1 impression—Brinell hardness			487	548		658	706	700	694
1 " Deformation mm.			.001	.0025		.005	.011	.011	.015
11 " Brinell hard.—av.	378	454	485	548	604	655	709	698	
11 " Total deform. mm.			.0012	.0037		.0075	.015	.014	
Brinell hardness, av. of 6 after 11 impressions on disk 4.	363	438	471	532	585	641	702	698	
5mm. *Carboloy Ball.* 750 Kg. load.									
1 impression—Brinell hardness			496	570		703	800	780	840
1 " Deformation mm.			.0012	.002		.0037	.0062		.0087
11 " Brinell hard.—av.	378	460	495	571	635	700	792		820
11 " Total deform. mm.			.0017	.0027		.005	.009		.014
Brinell hardness, av. of 3 after 100 impressions on disk 5.			490	568		690		780	
Brinell hardness, av. of 3 after 10 impressions on T.C.	380	456	484	560	622	685	770		



Graph 1

lum carbide sample the obtained Brinell numbers are lower.

Quick and Jordan found the flattening of a 10 mm. iron-carbon-vanadium ball to be about ½ the flattening of a Hultgren ball on hard material, but obtained only slightly higher Brinell number. The 5 mm. Carboloy ball also flattens about ½ of the 5 mm. Hultgren ball on hard material but gives noticeably higher Brinell number, which may be due to a greater modulus of elasticity of the sintered tungsten carbide.

In ordinary practice it is most convenient to use the ball in a fixed position in the holder and a conversion table for Rockwell C to Atlas-Carboloy ball should therefore be based on the values represented by the dotted line in the graph. The Carboloy ball would then give consistent results on material softer than 67 R.C. after a few preliminary impressions on the hard material. The Carboloy ball should not be used for harder material than about 67 on account of the greater deformation. Similarly, a Hultgren ball for general application should not be used for impressions on material over 62 R.C.

840 Brinell hardness. The subsequent 10 readings for the Carboloy ball averaged 820 and the corresponding ball deformations for the readings were respectively 0.009 mm. (0.00036") and 0.014 mm. (0.00056"). After these 10 impressions on the tantalum carbide specimen the Carboloy ball was used in the same position on disks 1, 2, 3, 6, 7 and 8, and the resulting hardness is not much below the values for the ball used 100 times on disk 5.

In order to show the results obtained on this material in comparison with some of the most comprehensive data previously published Petrenko's[3] curve as plotted from his empirical equation derived from experimental values obtained with 10 mm. balls at 3000 kg. for various samples is shown as a solid line in Graph 1 and the values in the table are given as points. Petrenko's individual values fall within ± 10% of his curve, and the average values obtained in the present experiments with new 5 mm. Hultgren balls practically coincide with Petrenko's curve from 46 to 62 R.C. However, if the values are taken with a Hultgren ball that has already been used on hard material, these latter values will be found lower than Petrenko's. This may be due to using both different standards and different Rockwell machines in the tests, and a direct comparison between the 2 tests can not now be made.

The average values obtained with the 5 mm. Carboloy balls are consistently higher than those obtained with 5 mm. Hultgren balls, and the difference increases with greater hardness of the sample but the average points are not more than 10% over Petrenko's curve. The first impression values are generally higher than those made later, but even values obtained on the softer disks after the Carboloy ball has been used 100 times on a hard disk are not much lower than the first. However, after the ball has been used 10 times on the hard tanta-

[3]*Bureau of Standards Journal of Research,* Vol. 5, July 1930, page 19.

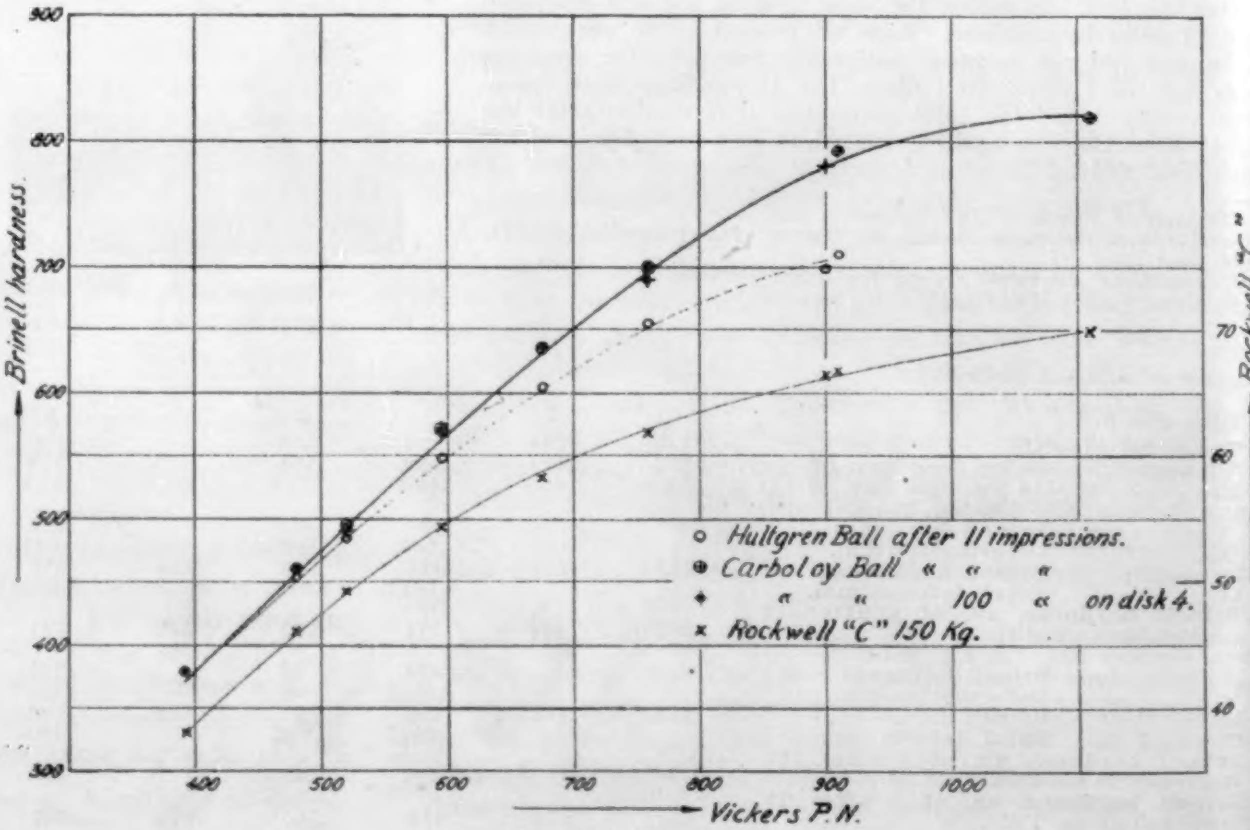
The relation between Vickers Pyramid number, 30 kg. load and Brinell readings with these 2 types of balls as well as with Rockwell C 150 kg. is shown in Graph 2. It is quite evident from this graph that the readings obtained with the Carboloy ball come much closer to being proportional to the Vickers P.N. than the Hultgren or Rockwell readings.

A further test of interest was made on the Carboloy ball. After 100 impressions on disk 5 the ball was turned slightly so that the first flattened portion would intersect a new impression. While the impression now became irregular in shape the mean of long and short axis still read about the same hardness as before, namely, 795 for 10 impressions on disk 5.

Carboloy balls have also been used to advantage for hardness testing at temperatures up to 1600°F. and no softening has been experienced.

Through the courtesy of N. L. Mochel, the Vickers Pyramid Numbers of these specimens were made at the metallurgical laboratory of the Westinghouse Electric & Manufacturing Company, Lester Branch.

The assistance of H. O. Walp of the SKF Research Laboratory in making the other tests is gratefully acknowledged.



Graph 2

The Resistance of Copper and Its Alloys to Repeated Stress

By H. W. Gillett*

Part IV. The Bronzes and Special Alloys

IT WAS pointed out in Part III of this review** that the brasses, even in the optimum cold-worked and stress-relieved condition yet obtained, do not give endurance limits as high as 30,000 lbs./in.², and are somewhat adversely affected by combined corrosion and repeated stress. The search for copper alloys of higher endurance must therefore extend into the bronzes and special alloys. The ordinary wrought tin bronzes and phosphor bronzes of Table 1 A give endurance limits of about the same magnitude as the brasses, all running below 30,000 lbs./in.². In Table 1 B there is one "bronze" mentioned by Gough[1] without stating the composition or the number of cycles of the endurance test, which is said to show 40,000 lbs./in.² endurance, but this may be a special bronze and not a tin bronze.

As was the case with copper and the brasses, there is indication (Nos. 3, 4 and 6, Table 1 A) that severe cold work, while it raises the tensile strength of rod stock, lowers the endurance limit, the softer bronzes showing higher endurance. This is not shown by the work of Townsend and Greenall[2] (No. 9-11, Table 1 A) on sheet, but the tendency is shown by the way the endurance ratio drops.

There are no data on cast phosphor bronze. Data on several commercial tempers and on alloys of low tin content, such as 1½% Sn, are lacking. The effect of changes in P for a given Sn content and vice versa have not been systematically covered.

Wrought aluminum bronze, however, with 8 to 12% Al and say 2 to 3% Fe, is, as Table 2 A shows, a material of valuable endurance properties, its endurance ranging from a minimum not much below the maximum for the brasses, up to a maximum of say 35,000 lbs./in.² for rolled, and 42,000 lbs./in.² for extruded material. No data on sheet are available. Cast aluminum bronze, properly heat-treated, appears to have from 25,000 to over 30,000 lbs./in.² endurance limit.

Manganese bronze (really a high strength brass), in spite of its good static properties, only gives about 18,000 lbs./in.² endurance limit. Modified compositions (Nos. 3 and 4, Table 3) used abroad, are reported with higher endurance, but without data on the number of cycles of the endurance test, so that few conclusions can be drawn in regard to them. Such data as exist on cast manganese bronze (Nos. 5, 6, Table 3) indicate that cast material is about as good in endurance as wrought material. An unusual low zinc composition (Nos. 10, 11, Table 3) in heavy castings, shows a very low endurance limit and low static properties as well.

Some of the wrought copper-nickel alloys with 40 to 50% Ni, and hence expensive, give endurance limits (Table 4) of the same order as those for aluminum bronze, and under corrosion fatigue do not appear as attractive as the aluminum bronzes.

Some of the special manganese-silicon-copper and nickel-silicon-zinc-copper alloys (Table 5) which have good static properties are disappointing in their endurance properties. The silicide alloys that are given high tensile strength by a precipitation-hardening heat treatment are prone to have a low endurance ratio so that their endurance limits lie pretty much in the same range as those of the ordinary brasses. On account of their high copper content, they may be good under corrosion-fatigue, but data on this, as well as on notched endurance tests and on cast alloys of this type, are lacking.

However, it is possible for a precipitation-hardened copper alloy to show outstanding endurance properties, for, while accurate data are still lacking, preliminary reports by Siemens and Halske[3] and Stock[4] state that a copper beryllium alloy of about 2½% Be, given a precipitation hardening treatment, has the unusual tensile strength of 192,000 lbs./in.² and stands 16 million cycles when stressed at nearly 100,000 lbs./in.², while in a comparable test, phosphor bronze broke in less than half a million cycles at 57,000 lbs./in.² Frank[5] claims that such an alloy stood 25 million cycles without failure at a stress at which a phosphor bronze spring alloy failed in 0.4 million cycles. He also states that in comparison with a standard spring steel which failed at a certain stress (not stated) in 2 million cycles, the Cu Be alloy had not failed at 3 million.

However, the National Physical Laboratory[6] states that failures of Cu Be spring plate material have been met in testing up to as much as 65 million cycles, and that tests must be carried to a very large number of cycles for accurate determination of the endurance limit.

The stress at which failure occurred at 65 million cycles is not stated. A still later account† of the N.P.L. work, which does not go into detail, indicates that the Cu Be alloy may not be sensitive to the notch effect, since the statement is made that in the case of spring-plate material repeated bend tests have indicated that any deleterious effect of the surface on "as rolled" plates, is small. Work on endurance of the Cu Be alloys is also in progress in this country.

It would seem probable that the Cu Be alloys will be found capable of being given the highest endurance limits of any known copper-base alloy. Their high copper content should give them good corrosion-fatigue properties, though this of course needs experimental verification. The possibility of forming the alloy in the soft state and then hardening it by heat treatment would make it attractive for the sylphon type of bellows and similar articles if it is found suitable for such uses.

Corrosion Fatigue. The data on corrosion fatigue for specimens listed in Tables 1-5 are summarized below:

Table	No.	Tensile	Endurance lbs./in.²	Corrosion Fatigue lbs./in.² Salt Water	Corrosion Fatigue lbs./in.² Carbonate Water
Bronzes					
1 A	4	86,500	17,000 (20)	....	16,000 (10)
1 A	6	94,500	17,000 (20)	....	17,000 (10)
1 A	7	81,000	22,000 (20)	....	17,000 (10)
1 A	8	55,500	21,000 (10)	20,000 (10)	....
1 A	13	81,500	23,000 (1½)	....	22,000 (20)
1 A	14	63,000	27,000 (40)	....	20000 to 23000 (50)
1 A	15	48,000	20,000 (100)	20,000± (12)	20,000± (12)
1 B	7	87,500	15,500 (10)	15,500 (10)	....
1 B	8	81,000	18,000 (10)	18,000 (10)	....
Aluminum Bronze					
2 A	11	99,000	35,000 (50)	....	25,000 (30)
2 A	12	91,500	27,000 (40)	....	24,000 (30)
2 A	14	90,500	38,000 (60)	23,000±	23,000 (50)
2 A	15	88,000	42,000 (20)	29,000 (20)	33,000 (50)
2 A	16	83,500	40,000 (15)	30,000 (50)	30,000 (10)
Cu Ni Alloys					
4	1	85,000	37,000 (100)	25,000±	24,000 (50)
4	2	----	32,000 (60)	25,000±	24,000±
4	3	96,500	41,000 (100)	21,000 (60)	20,000 (70)
4	4	66,500	30,000 (4)	22,000 (20)	21,000 (70)
4	11	98,000	36,000 (100)	....	22,000 (70)
4	12	70,500	26,500 (40)	....	22,000 (70)
4	13	62,500	25,500 (40)	....	20,000 (60)
4	14	47,500	18,000 (100)	18,000 (80)	18,000 (50)

It will be seen that the phosphor-bronzes do not as a rule have their fatigue limit much lowered by simultaneous corrosion in salt or carbonate water. The aluminum bronzes, though in some cases somewhat affected, have, as a class, higher corrosion fatigue limits than do the tin bronzes, and the aluminum bronzes are also, as a class, superior to the more expensive Cu Ni alloys.

The corrosion-fatigue limits as a rule are not much higher on cold-worked than on annealed material, where comparative figures are available. No data are available on corrosion fatigue of manganese bronze or of any of the special alloys of Table 5.

Notches. Ludwik[7] fails to find a lower endurance limit from the presence of notches on bronze of unknown composition (Nos. 7 and 8, Table 1 B), but, as previously pointed out, he fails to find a notch effect on materials which show it, according to data of other workers. The other data summarized below, chiefly on Cu Ni alloys from the work of McAdam[8], indicate that in the notched condition the Cu Ni type alloys come down to the same level, irrespective of how much higher their un-notched endurance limits may be.

*Battelle Memorial Institute.
***Metals & Alloys*, Vol. 3, Nov. 1932, page 257.

†Anon. The National Physical Laboratory. *Engineering*, Vol. 134, July 22, 1932, pages 102-103.

TABLE 1A. BRONZE AND PHOSPHOR BRONZE

No.	Worker	Mark	Composition Cu	Sn	P	Fe	Pb	Condition	STATIC Tensile Strength lbs./in.²	Elong. %	Red. Area %	Charpy Impact ft.-lbs.	Brinell Hardness	ENDURANCE Stress for 1 Million Cycles lbs./in.²	Endurance Limit lbs./in.²	No. Cycles Millions	Endurance Ratio	Notes
1	McAdam[9]	DD	89.39	10.60	.13	.08	....	Cold-rolled as received	83,000	38	63	....	....	34,000	27,000	(15)	(.33)	
2	McAdam	DD11	89.39	10.60	.13	.08	....	1100° F. 1 hr.	67,500	70	72	....	....	....	27,000	(30)	.40	
3	McAdam[10]	ECA4	89.41	10.49	.13	.07	....	400° F. 3 hrs.	91,500	32	65½	21	158	25,000	17,000	(10)	(.19)	
4	McAdam	EC4	89.41	10.49	.13	.07	....	400° F. 3 hrs.	86,500	35½	56	26½	121	32,000	17,000	(20)	.20	See text, corrosion fatigue
5	McAdam	ECA12	89.41	10.49	.13	.07	....	1200° F. 1 hr.	64,500	77	73	44	67	30,000	20,000	(100)	.31	
6	McAdam	EDA3.5	91.71	8.20	.13	.07	....	350° F. 4 hrs.	94,500	26	59	20½	....	28,000	17,000	(20)	.18	See text, corrosion fatigue
7	McAdam	ED4	91.71	8.20	.13	.07	....	400° F. 4 hrs.	81,000	37½	74	33½	121	30,000	22,000	(20)	.27	See text, corrosion fatigue
8	McAdam	ED12	91.71	8.20	.13	.07	....	1200° F. 1 hr.	55,500	84½	78	47	55	27,000	21,000	(10)	.38	See text, corrosion fatigue
	Sheet																	
9	Townsend & Greenall[2] 24 B&S Gage 0.02″ thick		91 min.	7.5-8.5	.03	.03	.02	Annealed	59,500	67	....	....	....	25,000*	20,000**	(100)	.33	
10	Townsend & Greenall[2] 24 B&S Gage 0.02″ thick		91 min.	7.5-8.5	.03	.03	.02	4 nos. hard	95,500	14	....	....	....	32,000*	20,500**	(100)	.21	
11	Townsend & Greenall[2] 24 B&S Gage 0.02″ thick		91 min.	7.5-8.5	.03	.03	.02	10 nos. hard	125,000	2	....	....	....	35,000*	24,500**	(100)	.20	
12	Bureau of Standards[11] Sheet ⅛″ thick		92.38	7.61	.01	....	....	Rolled	115,000	9	....	....	....	....	***	....	(approx. 0.20?) High speed test	
13	McAdam[10]	EAA3.75	94.55	5.42	.13	.07	....	375° F. 3 hrs.	81,500	25	64½	....	132	26,000	23,000	(1½)	(.28)	See text, corrosion fatigue
14	McAdam	EA4	94.55	5.42	.13	.07	....	400° F. 3 hrs.	63,000	37½	74	37	107	30,000	27,000	(40)	.43	See text, corrosion fatigue
15	McAdam	EHA12	94.55	5.42	.13	.07	....	1200° F. 1 hr.	48,000	71½	79½	50	56	24,000	20,000	(100)	.42	See text, corrosion fatigue
16	McAdam[8]	CK	95.00	5.06	.03	....	.01[a]	Cold-drawn as received	63,000	32½	75	....	....	32,000	±27,000	(60)	.43	See text, torsion fatigue
17	McAdam	BQ	95.61	4.66	.06	.03	....	Cold rolled as received	58,500	31½	71	....	....	....	....	....	....	See text, torsion fatigue
18	McAdam	F	95.74	4.20	.05	....	....	Cold rolled as received	66,500 *	21½	58½	....	....	....	29,000	(50)	.44	
19	Moore & Jasper[12]	104A	94.96	4.89	....	....	....	1290° F. Annealed	45,500	67	84	51½	74	35,000	±23,000	(100)	.50	See text, notched
20	Moore & Jasper	104B	94.96	4.89	....	....	....	Cold-drawn	85,000	11½	67	38	166	37,000	27,000	(40)	.32	
21	McAdam[9]	DG	95.57	4.05	.39	.09	.01	Cold-drawn as received	56,000	47½	79	....	....	27,500	22,500	(20)	.40	
22	McAdam	DG12	95.57	4.05	.39	.09	.01	1200° F. 1 hr.	48,000	71	80½	....	....	27,500	22,500	(30)	.47	
23	Tapsell[13]	....	....	3.5	.03	....	....	Rolled, as received	58,000	....	....	....	....	....	27,000	(10)	(.47?)	Axial loading, Haigh machine

[a]Analysis given adds up over 100%.

*From published data.

**Slightly lower than published data. Corrected by personal communication from Mr. Townsend.

***Preliminary test. Bar at 26,000 lbs./in.² broke at 6.2 million cycles; one at 21,000 lbs./in.² broke at 5.1 million cycles.

TABLE 1B. "BRONZES," ANALYSIS AND CONDITION NOT GIVEN

No.	Worker	Mark	Composition	STATIC Tensile Strength lbs./in.²	Elong. %	Red. Area %	ENDURANCE Stress for 1 Million Cycles lbs./in.²	Endurance Limit lbs./in.²	No. Cycles Millions	Endurance Ratio	Notes
1	Gough[1]		"Phosphor Bronze"	58,500	....	....		28,500	(?)	(.49?)	
2	Gough		"Phosphor Bronze"	42,000	....	....		21,500	(?)*	(.51?)	
3	Gough	ACH4	"Bronze"	80,500	....	....		40,000	(?)**	(.50?)	
4	Schwinning & Stroebel[14] 1.75 mm. diam.		"Bronze"	76,500	....	....	27,000 (2 million)			....	
5	Schwinning & Stroebel[14] 3.6 mm. diam.		"Bronze"	68,000	....	....	22,500 (2 million)			....	
6	Schwinning & Stroebel [14] 4.5-4.55 mm. diam.		"Bronze"	60,000	....	....	20,500 (2 million)			....	
7	Ludwik[7]	A	"Forging Bronze"	87,500	24½	28		15,500***	(10)	(.18?)	See text, corrosion-fatigue, torsion, and notched
8	Ludwik	B	"Forging Bronze"	81,000	25½	35½		18,000***	(10)	(.22?)	
9	Swinning[15]		"Bronze"	72,000	....	....		22,000	(20)	(.31)	
10	Haigh[16]		"Phosphor Bronze"	63,000	49	63	34,000 axial	....	....	....	

*Gough states that the short-cut "load-deflection method" gave 20,500 lbs./in.².

**Gough states that the short-cut "load-deflection method" gave 38,500 lbs./in.². This may perhaps be some other type of "bronze" instead of a tin bronze.

***These may not be tin bronzes—no composition given; according to the usual terminology they might be either a 6% Sn phosphor bronze or an aluminum bronze of 86-90% Cu, 8-12% Al, and 1-2% Fe.

Table	No.	Tensile	Endurance lbs./in.^{2}	Endurance Notched lbs./in.^{2}	Notch
Bronzes					
1 A	4	45,500	23,000 (100)	20,500	5/64" radius round groove
1 B	7	87,500	15,500 (10)	15,500 (10)	0.2 mm. deep, 0.05 mm. radius
1 B	8	81,000	18,000 (10)	18,000 (10)	0.2 mm. deep 0.05 mm. radius
Aluminum Bronze					
2 A	5	77,500	34,000 (70)	20,000 (25)	60° notch, 0.038" deep,
2 B	4	78,000	26,000 (70)	22,000 (15)	0.055" wide, 0.01" radius at base
Cu Ni Alloys					
4	11	98,000	36,000 (100)	20,000 (?)	
4	12	70,500	26,500 (40)	20,000 (?)	
4	18	87,500	33,500 (50)	20,000 (?)	
4	19	97,500	32,500 (60)	20,000 (?)	

Torsion. Such torsional endurance data as are available on the materials of Tables 1-5 are collected below.

Table	No.	Tensile lbs./in.^{2}	Torsion lbs./in.^{2}	Angle of Twist	Endurance Limits lbs./in.^{2} Rotary Beam	Torsion
Bronzes						
1 A	16	63,000	50,500	618°	27,000 (60)	....
1 A	17	58,500	52,500	810°	--------	12,000 (70)
1 B	7	87,500	....	....	15,500 (10)	8,500 (10)
Aluminum Bronze						
2 A	8	87,000	60,000	217°	23,000 (60)	13,000 (50)
2 A	9	83,500	44,500	72°	28,000 (80)	14,000 (50)
2 A	11	99,000	60,500	60°	35,000 (50)	17,000 (80)
2 A	17	72,000	52,500	396°	19,000 (100)	12,000 (40)
Cu Ni Alloys						
4	7	70,500	66,000	976°	34,500 (?)	14,500 (?)
4	8	70,500	60,000	1023°	--------	17,000 (?)
4	19	97,000	69,500	243°	32,500 (60)	20,000 (50)
Miscellaneous						
Schmidt	9	65 Cu 25 Pb 6 Ni 2 Sn 2 Zn			10,000 (2)	5,700 (2)
Schmidt		85 Cu 9 Sn 4 Ni 2 P			11,500 (2)	9,000 (2)
(No static properties given)						

There is a fairly close approach in most cases to what appears to be the normal relationship, i. e., the torsion endurance limit approximating 50% of that for rotary bending.

Summary. Phosphor bronze is relatively immune to corrosion fatigue in salt or fresh water, but does not have a very high endurance limit to start with. Aluminum bronze is outstanding for endurance limit and for corrosion-fatigue resistance, among commercial materials.

Copper-beryllium alloys, with a precipitation-hardening heat-treatment appear to be, on incomplete data, of outstanding possibilities.

Cast aluminum bronze, properly heat-treated, has almost as good endurance as the wrought material. Almost no data are available on ordinary bronze and red brass castings. Professor Sachs, in Germany, is studying these, but his data are not yet complete.

On account of the relatively low tensile strength of such alloys and the low endurance ratio generally found on wrought alloys of that class, their endurance limits may be expected to be low.

Many commercial compositions and tempers of wrought bronzes and special alloys have not been studied in respect to endurance. In spite of the hundreds of individual endurance tests that have been tabulated in this series of articles, much remains to be done before the endurance properties of copper and its engineering alloys are thoroughly understood.

Because of the inapplicability of short-cut tests, the necessity for running to a very large number of cycles and the variety of the endurance ratio (which makes it impossible to make even a good guess at the endurance limit from the static properties, as can be done with steel), a complete survey would be a tedious task.

However, the variability of the endurance ratio and the facts already on record as to the importance of avoidance of over-cold-working and of stress-release, offer hope for the development of copper-base alloys of decidedly improved endurance properties over those now met in commercial alloys, by means of a systematic study of the alloys aimed to develop better endurance. Similar studies on aluminum alloys are resulting in the production of new alloys that may have only mediocre static properties, but are superior in endurance, for uses where endurance is the most important property. Such improvements in the copper-base alloys also might well result from increased attention to their endurance properties.

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TABLE 2A. WROUGHT ALUMINUM BRONZE

No.	Worker	Mark	COMPOSITION Cu	Al	Fe	Mn	Misc.	Condition	STATIC Tensile Strength lbs./in.^{2}	Elong. %	Red. Area %	Charpy Impact ft.-lbs.	Brinell Hardness	ENDURANCE Stress for 1 Million Cycles lbs./in.^{2}	Endurance Limit lbs./in.^{2}	No. Cycles Millions	Endurance Ratio	Notes
1	Carpenter[17] & Edwards	13	90.10	9.90				Rolled 13/16" rod	84,000	29	31		210	29,500				
2	Rosenhain & Lantsberry[18]	2	89.06	10.02		.92		Rolled 13/16" rod	96,000	22½	33½			27,500				
3	Rosenhain & Lantsberry	3	88.30	9.82		1.88		Rolled 13/16" rod	91,000	29	32			27,500				
4	Rosenhain & Lantsberry	6	88.11	8.91		2.98		Rolled 13/16" rod	89,500	39	43½			27,500				
5	R. R. Moore[19]	6	89.81	10.06	.13			Extruded 1650°F. water 1150°	77,500	35½	34	13½	128	47,000	34,000	(70)	.43	(See text, notched)
6	McAdam[20]	KE-6	90.39	10.00	.17[a]			600°F. 3 hrs.	75,000	20	26	25			28,000	(?)	(.37?)	
7	McAdam	KF-6	87.69	10.50	2.64			600°F. 3 hrs.	100,000	16½	17½	14			31,000	(?)	(.31?)	
8	McAdam[8]	BJa	90.91	9.10	tr			Rolled as received	87,000	34	54½				23,000	(60)	.26	(See text, torsion)
9	McAdam	BJb	90.52	10.01	tr			Rolled as received	83,500	38	39				28,000	(80)	.34	(See text, torsion)
10	McAdam	BJbl	90.52	10.01	tr			1200°F. 1 hr.	62,500	24	23			27,000±	20,000	(50)	.32	
11	McAdam	BJc	87.12	10.40	2.92			Rolled as received	99,000	30½	40			38,000	35,000	(50)	.35	(See text, torsion and corrosion fatigue)
12	McAdam	CM	87.00	9.60	3.40			Rolled as received	91,500	27½	28½	14		30,000	27,000	(40)	.30	(See text, corrosion fatigue)
13	McAdam	CM12	87.00	9.60	3.40			1200°F. 1 hr.	91,500[b]	27½[b]	28½[b]	14[b]		30,000[b]	27,000[b]			
14	McAdam	1A	88.67	7.49	2.89	.14	(.81 Ni)	As received	90,500	34½	36	22		45,000	38,000	(60)	.42	(See text, corrosion fatigue)
15	McAdam	1C	86.71	9.93	3.10		(.26 Sn)	Extruded as received	88,000	11½	14½	5½			42,000	(20)	.48	(See text, corrosion fatigue)
16	McAdam	1CA	83.60	12.57	3.40	.43		Extruded as received	83,500	¾	3½	2½			40,000	(15)	(.48)	(See text, corrosion fatigue)
17	McAdam	BJ	94.85	5.62	.07			Rolled as received	72,000	43	65½			24,000	19,000	(100)	.27	(See text, torsion)
18	Carpenter & Edwards[17]	1	99.90	.10				Rolled 13/16" rod	32,500	65½	91		66	13,000	(½ million)			
19	Carpenter & Edwards	4	97.01	2.99				Rolled 13/16" rod	44,500	57	86		102	22,000	(½ million)			
20	Carpenter & Edwards	6	94.93	5.07				Rolled 13/16" rod	57,000	69	78		124	24,500				
21	Carpenter & Edwards	9	92.65	7.35				Rolled 13/16" rod	63,000	72½	74½		134	24,500				

[a] Analysis given adds up over 100%.
[b] Static and endurance results same for material as received and annealed.

TABLE 2B. CAST ALUMINUM BRONZE

No.	Worker	COMPOSITION Cu	Al	Fe	Condition	STATIC Tensile Strength lbs./in.²	Elong. %	Red. Area %	Charpy Impact ft.-lbs.	Brinell Hardness	ENDURANCE Stress for 1 Million Cycles lbs./in.²	Endurance Limit lbs./in.²	No. Cycles Millions	Endurance Ratio	Notes
1	Corse & Comstock[21]	88.63	10.67	.91	As cast[a]	77,000	30½	27½			35,000	26,000	(13)	(.34)	
2	Corse & Comstock	88.63	10.67	.91	Heat treated[b]	88,500	15	17½			40,000	32,000	(14)	(.36)	
3	R. R. Moore[19]	90.22	9.78		As cast[c]	59,000	20	28	6½	96	27,000	22,000	(50)	.37	
4	R. R. Moore	90.22	9.78		Heat-treated[b]	78,000	14	19	13	142	27,000	26,000	(70)	.33	See text, notched
5	Genders, etc.[22]	90.3	9.7		Chill cast 1″ rod	67,000[d]	14[d]	17[d]		126		29,000[d]	(?)	(.42?)	

[a]Cast half in sand, half in chill.
[b]1560°F., quenched in water, drawn at 1200°F.
[c]Cast in keel block test bar.
[d]Static properties on die casting 0.564″ diameter. Endurance on 1″ chill cast rod.

TABLE 3. MANGANESE BRONZE TYPE

No.	Worker	Mark	Composition Cu	Zn	Sn	Fe	Al	Mn	Ni	Pb	Condition	STATIC Tensile Strength lbs./in.²	Elong. %	Red. Area %	ENDURANCE Stress for 1 Million lbs./in.²	Endurance Limit lbs./in.²	No. Cycles Millions	Endurance Ratio
1	McAdam[8]	BG	58.19	40.10	1.04	.65	....	....	....	.02	Hot-rolled as received	75,500	33½	44	27,000±	18,000	(100)	.24
2	Irwin[23]		Analysis not given								Forged	105,500	8	17	....	16,000 (?)	(17,500 axial loading)	.15 (.17 axial)
3	Döring[24]	Finow Marine Bronze	57.5	40.7	.8	....	.15	....	.80	.05	Not stated	83,500	....	....	....	25,000[c]	(?)[c]	(.30?)
4	Corse & Comstock[21]		56.	41.	1.	1.	.5	.5	....	....	Cast[a]	87,500	25	25	27,000	19,000	(6)	(.22?)
5	R. R. Moore[19]		56.85	40.90	.32	1.50	.23	.20	....	....	Cast[b]	70,000	33	41	26,000	17,000	(250)	.24
6	Hengstenberg[38]		64.	22.	....	2.45	5.30	5.80	....	.04*	Cast	....	....	....	22,000	16,000	20	....
7	Hengstenberg		64.	22.	....	2.45	5.30	5.80	....	.04*	Forged	105,500	8	17	24,500	17,500	20	.17
8	Hengstenberg		57.	34.	....	2.10	3.40	3.43	....	....	Forged	96,000	15	18	22,000	12,000	20	.13
9	Hengstenberg		75.97	17.40	3.42	.07	....[d]	....[d]	....	3.20	Cast 3″ diam.	19,700	18	21	8,000	7,200	20	.37
10	Hengstenberg		75.97	17.40	3.42	.07	....[d]	....[d]	....	3.20	Cast 5″ diam.	20,150	23	24	7,000	5,800	20	.27

[a]Cast half in sand, half in chill.
[b]Cast in keel block test bar—21 Charpy, 29½ Izod, 93 Brinell.
[c]Only 8% increase in endurance obtained by cold-working the surface of the specimen.
[d]Not a manganese bronze.
*Also contains 0.05% Si.

TABLE 4. COPPER NICKEL ALLOYS

No.	Worker	Mark	COMPOSITION Cu	Ni	Mn	Fe	P	Si	C	Misc.	Condition	STATIC Tensile Strength lbs./in.²	Elong. %	Red. Area %	Charpy Impact ft.-lbs.	ENDURANCE Stress for 1 Million Cycles lbs./in.²	Endurance Limit lbs./in.²	No. Cycles Millions	End. Ratio	Notes
1	McAdam[a]	EI	48.37	48.33	1.90			.05	.23		Cold-rolled	85,000	34½	60½		48,000	37,000	(100)	.44	(See text, corrosion fatigue)
2	McAdam	Ann.	48.37	48.33	1.90			.05	.23		1400°F. 1 hr.	Not given	45½	61½		35,000	32,000	(60)	....	(See text, corrosion fatigue)
3	McAdam	HP7 Ann.	53.54	45.00	1.03	.38		.02	.04		Cold-rolled & 750°F. 3 hrs.	96,500	22	70½	53	49,000	41,000	(100)	.43	(See text, corrosion fatigue)
4	McAdam	HP2	53.54	45.00	1.03	.38		.02	.04		1200°F. 1 hr.	66,500	47	78	77½		30,000	(4)	(.45?)	(See text, corrosion fatigue)
5	McAdam	CV	53.71	44.77	.86	.66			.08		Cold-rolled as received	103,500	15	70		49,000	43,000	(40)	.42	
6	McAdam	CV14-5	53.71	44.77	.86	.66			.08		1450°F. 1 hr.	69,500	48½	78½		31,000	28,000	(8)	(.40?)	
7	McAdam	CE	53.77	44.68	1.14	.52			.11		Hot-rolled as received	70,500	48½	78½			34,500	(?)	(.49?)	(See text, torsion)
8	McAdam	CE-1	53.77	44.68	1.14	.52			.11		1500°F. 1 hr.	70,500	48½	79½						(See text, torsion)
9	McAdam	EH	56.63	40.29	1.44	1.02		.02	.16	.04 S	Hot-rolled as received	78,000	32½	60	45	40,000	32,500	(?)	(.42?)	(See text, notched)
10	McAdam	EH14	56.63	40.29	1.44	1.02		.02	.16	.04 S	1400°F. 1 hr.	72,000	47	66½	45½	33,000	30,000	(?)	(.42?)	
11	McAdam	HZ8.5	67.11	28.66	1.35	2.82	.008		.04	.006 S	Cold-rolled & 850°F. 3 hrs.	98,000	18	54	38	46,000	36,000	(100)	.37	(See text, corrosion fatigue and notched)
12	McAdam	HZ14-5	67.11	28.66	1.35	2.82	.008		.04	.006 S	1450°F. 1 hr.	70,500	45½	71½	66	29,000	26,500	(40)	.37	(See text, corrosion fatigue and notched)
13	McAdam	HE4	77.92	21.24	.29	.51	.031		.03	.011 S	400°F. 1 hr.	62,500	22½	68	24½	31,000	25,500	(100)	.41	(See text, corrosion fatigue)
14	McAdam	HE14	77.92	21.24	.29	.51	.031		.03	.011 S	1400°F. 1 hr.	47,500	50	75	47	21,000	18,000	(100)	.38	(See Text, corrosion fatigue)
15	McAdam	B	80.34	19.23	.12	.27					Cold-rolled as received	50,000	36	67½			17,500	(50)	.35	
16	Moore, H. F.	⅜″	79.20	20.24	.20	.36						Not Stated					20,000	(5)[a]		
17	Moore, H. F.	1″	79.82	19.64	.22	.37						Not Stated					20,000	(5)[a]		
	Copper-Nickel-Tin																			
18	McAdam[8]	CF	69.82	29.08		.27				.95 Sn	Cold-drawn as received	87,500	4	22		40,000	33,500	(50)	.38	(See text, notched)
	Copper-Nickel-Chromium																			
19	McAdam[8]	D	58.93	34.15	1.61	1.04		.13		4.14 Cr	Forged as received	97,000	22	46½			32,500	(60)	.34	(See text, torsion and notched)

[a]Tests on turbine blading shapes.

TABLE 5. SPECIAL HIGH-COPPER ALLOYS

No.	Worker	Mark	COMPOSITION Cu	Ni	Si	Zn	Mn	Fe	Be	Condition	STATIC Tensile Strength lbs./in.²	Elong. %	Red. Area %	Rockwell B	ENDURANCE Stress for 1 Million Cycles lbs./in.²	Endurance Limit lbs./in.²	No. Cycles Millions [a]	Endurance Ratio	
1	Tapsell[13]	Cu Mn	96.4	....	....	....	3.6	....	....	Annealed	40,000	....	....		....	17,000	(10)	(.42?)	Axial loading, Haigh Machine
2	McAdam[8]	KBA8	95.96	3.27	.82	....		.09	....	Heat treated final 800°F. 2 hrs.	122,500	6	12		....	25,000	(?)	(.20?)	
3	Townsend & Greenall[2] Sheet No. 24 B&S Gage 0.02″ thick	33	87.22	2.32	.57	9.89				(Heat-treated)	90,000	14	....	86	17,000	14,000	(100)	.16	
4	Townsend & Greenall[2] Sheet No. 24 B & S Gage 0.02″ thick	34	77.17	2.37	.57	19.89				(1470°F. water then 930° F. 1 hr. draw)	86,000	21½	....	85	16,000	12,500	(100)	.15	
5	Townsend & Greenall[2] Sheet No. 24 B & S Gage 0.02″ thick	35	66.90	2.36	.66	30.12				(750° F. 1 hr. draw)	85,500	28	....	79	26,000	16,000	(100)	.19	
6	Townsend Greenall[2] Sheet No. 24 B & S Gage 0.02″ thick	Everdur	96.	....	3.	....	1.			Spring temper	80,000	22	....	91	32,000	24,000	(100)	.30	
7	Townsend[27]	Everdur	96.	....	3.	....	1.			8 Nos. hard	90,000	5	....	....	....	23,500	(100)[a]	.26	
8	Wright Field[28] Tubing ⅝″ O D 0.05″ Wall	Everdur	95.71	....	3.92	....	.98	.22		Somewhat cold-worked	67,000	49	....	....	27,000	24,000	(100)	.36	Polished inside and out.
9	Wright Field[28] Tubing ⅝″ O D 0.05″ Wall	Everdur	95.71	....	3.92	....	.98	.22		Somewhat cold-worked	67,000	49	....	....	....	18,000	(100)	.29	Commercial finish
10	Wright Field[28] Tubing ⅝″ O D 0.05″ Wall	Everdur	95.71	....	3.92	....	.98	.22		Annealed	52,000	52½	....	....	17,000	11,000	(100)	.21	Commercial finish
11	Wright Field[28] Tubing ⅝″ O D 0.05″ Wall	Alloy	94.95	....	....	4.11	.86	.08		Cold-worked	45,000	45½	....	107	19,000	13,000	(100)	.29	Extra smooth outside surface
12	Wright Field[28] Tubing ⅝″ O D 0.05″ Wall	Alloy	94.95	....	....	4.11	.86	.08		Cold-worked	42,500	52½	....	103	17,000	10,000	(100)	.24	Commercial finish
13	Siemens & Halske[3]	....	97.4	....	....	....	....	....	2.6	Heat-treated quenched, rolled, annealed, cold stretched, then tempered 1 hr. at 660° F.	192,000	¾	....	Brinell 375	....	99,500? See text	(16)	(.52?)	

[a] New Data Townsend

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[15] Prof. Swinning quoted by C. Pramaggiore. Conduttori in lega di alluminio. I conduttori in Aldrey. *Alluminio,* Vol. 1, 1932, pages 80-107 (page 84).

[16] B. P. Haigh. Experiments on the Fatigue of Brasses. *Journal Institute of Metals,* Vol. 18, 1917, pages 55-77. Discussion, pages 78-86.

[17] H. C. H. Carpenter & C. A. Edwards. Eighth Report to the Alloys Research Committee: On the Properties of Alloys of Aluminium and Copper. *Proceedings Institution of Mechanical Engineers,* 1907, pages 57-269. Discussion, pages 270-378.

[18] W. Rosehain & F. C. A. H. Lantsberry. Ninth Report of the Alloys Research Committee: On the Properties of Some Alloys of Copper, Aluminum, and Manganese. (With an Appendix on the Corrosion of Alloys of Copper and Aluminum When Exposed to the Sea.) *Proceedings Institution of Mechanical Engineers,* 1910, pages 119-292. Discussion, pages 293-339.

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R. R. Moore. Some Fatigue Tests on Non-Ferrous Metals. *Proceedings American Society for Testing Materials,* Vol. 25, Part 2, 1925, pages 66-83. Discussion, pages 84-96.

[20] D. J. McAdam, Jr. Influence of Stress on Corrosion. *American Institute of Mining and Metallurgical Engineers, Technical Publication* No. 417, 1931, 39 pages.

[21] W. M. Corse & G. F. Comstock. Aluminum Bronze: Some Recent Tests and Their Significance. *Proceedings American Society for Testing Materials,* Vol. 16, Part 2, 1916, pages 117-144. Discussion, pages 145-150.

[22] R. Genders, R. C. Reader & V. T. S. Foster. Die-Casting of Copper-Rich Alloys. *Journal Institute of Metals,* Vol. 40, 1928, pages 187-218.

[23] P. L. Irwin. Fatigue of Metals by Direct Stress. *Proceedings American Society for Testing Materials,* Vol. 25, Part 2, 1925, pages 53-63. Discussion, pages 64-65.

[24] H. Döring. Das Drücken der Oberfläche und der Einfluss von Querbohrungen auf die Biegungsschwingungsfestigkeit. *Veröffentlichungen des Wöhler-Instituts,* Heft 5, 1930, 50 pages.

[25] T. F. Henstenberg. Westinghouse Electric & Manufacturing Co., personal communication.

[26] H. F. Moore, S. W. Lyon, & N. J. Alleman. Tests of the Fatigue Strength of Steam Turbine Blade Shapes. *University of Illinois, Engineering Experiment Station, Bulletin* No. 183, 1928, 36 pages.

[27] J. R. Townsend. Bell Telephone Research Laboratories, personal communication.

[28] J. B. Johnson, Jr., Wright Field, personal communication.

Since this correlated abstract was prepared, Gough and Sopwith* have reported on some tests in vacuo. The specimen was enclosed in a sylphon bellows, which was evacuated down to about a millionth of an atmosphere, while the specimen was under repeated axial stress in a Haigh machine. Preliminary tests in a less perfect vacuum had also indicated no effect on a larger series of steels, little on a magnesium alloy with 2½% Al, and wide scatter on duralumin with apparently some improvement due to exclusion of air during the test.

In the tests in a high vacuum a carbon and a Ni Cr steel showed no detectable difference between results in air and in vacuo. An annealed 80:20 cupro nickel (with 0.19% Fe) of 50,000 lbs./in.^{2} tensile, 44% elongation, 68% reduction also gave the same endurance limit, 18,000 lbs./in.^{2}, as in air.

Annealed copper (0.04% oxygen, traces of Pb and As) of 32,500 lbs./in.^{2} tensile, 59% elongation, 74% reduction, gave 10,000 lbs./in.^{2} endurance limit (30 million cycles) in air or lanolin, and is estimated from three tests to 20 million cycles to have an endurance limit in the high vacuum of 11,000 lbs./in.^{2}. The evidence on copper is not very conclusive due to the small number of tests.

But annealed 70:30 brass (with 0.04% Fe, trace Pb) of 44,500 lbs./in.^{2} tensile, 84% elongation, 85% reduction giving 16,000 lbs./in.^{2} endurance limit on a 20 million cycle basis either in air, or when covered with lanolin, rose to 20,500 lbs./in.^{2} in the high vacuum. This reported behavior of brass appears striking, since the S-N curve seems to be quite clearly established, 8 specimens having been used. The stress for a life of 3 million cycles was 22,500 lbs./in.^{2} in vacuo and 16,500 in air. The authors conclude that the improvement in endurance due to prevention of access of air during repeated stress, although clearly indicated only in one of the materials tested, proves that the "air endurance limit" can no longer be regarded as the standard limiting stress.

No sign of the corrosion postulated to explain the lower results on brass in air could be seen on the tested specimens. Further tests are planned to try to find whether the postulated invisible corrosion is to be ascribed to oxygen or to water vapor. The air endurance limit of the brass is stated to agree with that determined on the same material and with the same Haigh machine some five years before. But Gough** tabulates, in his book, for material No. 100, annealed 70:30 brass of the same mark (B1F1) and same analysis and static properties as the brass used in these tests, an endurance limit in rotary bending for 60 million cycles, of 20,000 lbs./in.^{2}. These rotary bending tests are not referred to in the article by Gough and Sopwith.

If the same material shows the same endurance limit in air in rotary bending that it does in vacuo in axial repeated stress tests, but falls down in air on the latter type of test, the situation becomes still more complicated. Since a marked difference between tests in air and in vacuo appeared only in the case of this lot B1F1 of 70:30, it will be well to await further data before drawing very sweeping conclusions.

*Gough, H. J. and Sopwith, D. G. Atmospheric action as a factor in Fatigue of Metals. Preprint No. 611, *Institute of Metals,* for September, 1932 meeting, 20 pages.

**Gough, H. J. The Fatigue of Metals. Scott, Greenwood & Co., London, 1926. Pages 286-287.

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Readers' Comments, continued from page 269

complete aging and yields maximum hardness. If precipitation has not been complete in the quenching bath, it may continue, with increased hardness, at room temperature or by artificial aging at a temperature slightly higher for a short time until maximum hardness is obtained. This has been observed. Aging at higher temperatures (tempering) results in agglomeration of the precipitated carbide particles resulting in the formation of troostite and of sorbite and in decreased hardness as demanded by the precipitation theory. If the transformation of austenite takes place slowly at some 700°C. submicroscopic particles of the carbide must likewise form (the martensitic stage) before agglomeration giving rise to troostite, sorbite and pearlite can occur. In the transformations we are studying, constituents cannot reach microscopic dimensions without first passing through the submicroscopic stage.

Messrs. Guthrie and Comstock express the belief, shared by others, that on slow cooling austenite transforms directly to pearlite without passing through the troostitic and sorbitic stages. It is an important question and one which should be settled to the satisfaction of all.

The ferrite and the cementite lamellae, of which pearlite is constituted, did not spring full grown from mother austenite. Their birth and growth involve two transformations (1) an allotropic transformation of the solvent, which changes from γ to α iron, and (2) a precipitation of the carbon out of solution as the carbide Fe_3C. Like all crystalline transformations, these changes are gradual. They proceed from zero to completion, passing through submicroscopic and increasing microscopic dimensions; submicroscopic α grains must form within the γ matrix and increase in size and number until the allotropic transformation is completed. Likewise, submicroscopic particles of cementite must form and increase in size and number before the rejection is completed. Stages must necessarily be passed through when the alloy contains both γ and α iron in various proportions, and both crystallized Fe_3C and carbon in solution before reaching pearlitic equilibrium. The very nature of the transformations demands it. Those stages correspond to the so-called transition constituents, troostite and sorbite. It follows from the above considerations that no exact composition can be ascribed to these constituents. They represent various phases in the agglomeration of the carbide particles and in the extent of the allotropic transformation. Will not some one indicate the fallacy of this reasoning and explain how full grown lamellae of α ferrite and of cementite may form from a solid solution of carbon in γ iron without being at their birth of submicroscopic size, without their gradual increase to microscopic dimension, without passing through aggregates of γ and α iron, of crystallized Fe_3C and carbon in solution?

The microstructure obtained by Messrs. Guthrie and Comstock in which they find martensite and pearlite in close juxtaposition appears to me to have little significance in view of the manner in which the experiment was conducted. In order to trap in the quenching bath the austenite in process of transformation and, therefore, exhibiting the transition constituents troostite and sorbite, it is necessary to have a thermal gradient extending from the austenitic range into the pearlitic range. In their experiment, this heat gradient was so narrow as to be practically non-existent. Consider that the lead bath was kept at a temperature of only 1300°F. while the critical transformation is given as 1290°F. a gradient of 10°F. Had they kept their lead bath at a higher temperature, 1500°F. for instance, I believe that they would have found troostite associated with martensite. Similar experiments have been frequently performed.

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Percent Elongation in the Tensile Test as a Method of Measuring the Ductility of Thin Sheets

To the Editor of Metals & Alloys:

I have just received the October copy of Metals & Alloys and note with considerable interest, the article by Mr. Reid L. Kenyon, "Percent Elongation in the Tensile Test as a Method of Measuring the Ductility of Thin Sheets." In the second column of this article on page 220, under the general heading, "Outline of Tests," Mr. Kenyon makes the statement in the first sentence . . . "but in these tests there was no variation in length of parallel section for a given gage length." This is not in agreement with the facts as can be seen by reference to the paper referred to. Opposite page 380 of the A.S.T.M. Proceedings Vol. 26, 1926, Part II, will be found the detailed dimensions of the whole series of specimens where the parallel section was varied, as well as, the width of the specimen, while the gage length was maintained at 2 in. throughout. The data from these tests will be found on pages 382 and 383 and 384. The results have been plotted in Fig. 6, page 386, to show the relations between elongation and length of reduced section.

It is indeed a pleasure to see that Mr. Kenyon's results give the same answer that I obtained in the earlier tests, to wit: that the length of reduced section does not appreciably affect the elongation results as long as the parallel section is slightly longer than the gage length used.

R. L. Templin,

Chief Engineer of Tests
Aluminum Research Laboratories

New Kensington, Pa.
Oct. 1, 1932.

CURRENT

METALLURGICAL ABSTRACTS

A digest of the important metallurgical developments of the world

METALLURGICAL ABSTRACTS, incorporated in METALS & ALLOYS, is the most complete review of metallurgical literature (periodicals, books, etc.) available. Fifty section editors and abstractors cover over 500 domestic and foreign publications and abstract the articles on metallurgical engineering as well as allied subjects.

Upon receipt of the abstracts they are checked against permanent files to avoid duplication and after being rewritten to conform with our style they are classified. The section editors edit the abstracts appearing in the section in which their major interest lies.

There are usually at least two places where an abstract might fit, sometimes even more, and so we decide who will be most interested in the article. We want the abstracts to be so arranged that if a heat treater reads only Section 10 he will keep in touch with all the important articles in his field and if a foundryman will read Section 22 each month he will not miss anything important. An improvement we hope to make in the METALLURGICAL ABSTRACTS in the near future is the cross-indexing of articles which belong under several sections. Some of the sections are descriptive and some are self-explanatory and we have so labeled them.

CLASSIFICATIONS

0 (General). Under this heading we classify all abstracts which are of interest to the metallurgical industry in general.

1, 2, 3 (Properties of Metals, Non-Ferrous and Ferrous Alloys). An article goes under one of these heads when the properties are emphasized and not the method of determining them.

4 (Corrosion, Erosion, Oxidation, Passivity & Protection of Metals & Alloys). This takes articles on weather resistance, resistance to acids, etc. and protection against them.

5a (Structure of Metals & Alloys—Metallography & Macrography) An article would go in this group if it discussed the microscopic or macroscopic study of metals and alloys, or the determination of constitutional diagrams, critical points, etc.

5b (Structure of Metals & Alloys—Structure and X-Ray Analysis). This group includes articles dealing with the structure of metals and alloys as determined by X-ray analysis and X-ray examination.

6 (Physical, Mechanical & Magnetic Testing). If an article emphasizes the method of determining the properties of metals rather than the properties themselves it belongs in this section. The abstracts on fatigue appearing under this section are prepared with the coöperation of the Fatigue Research Committee of the American Society for Testing Materials.

7a (Electro-Chemistry—Electroplating). This will include articles on the electrolytic plating of metals.

7b (Electro-Chemistry—Electrometallurgy). This relates to the electrolytic recovery and refining of metals.

8 (Metallic Coatings Other than Electroplating). Articles on galvanizing, metal spraying or dip coating would come in this group.

9 (Industrial Uses and Applications). If the application of the metal is stressed rather than the properties the article belongs in this section.

10 (Heat Treatment). If heat treatment in general is discussed the article would be classed under section 10; if, however, any distinct operation is stressed it would go under the corresponding subhead.

11 (Joining of Metals and Alloys). The explanation for this group is similar to that for section 10.

12 (Working of Metals & Alloys.) We feel that the divisions in this group are self-explanatory to men in the metals industries. We might say, though, that an article is classified under 12j (Cold Working) only when it will not fit under one of the other heads—for instance, an article on cold rolling would be put under 12c, rolling.

13 (Defects). This section includes articles dealing with inclusions, segregations, cracks, pinholes, blowholes and failures.

14 (Chemical Analysis). If the method of analysis is emphasized the article goes here.

15 (Historical & Biographical). Self-explanatory.

16 (Economic). Articles in this group are devoted to economic trends, savings, cost estimates, etc.

17 (Plants & Laboratories). This section includes descriptive articles.

18 (Machinery & Supplies). This includes descriptive articles.

19 (Bibliographies). Self-explanatory.

20 (Miscellaneous). This takes in all scattered articles which do not belong anywhere else.

21 (Laboratory Apparatus). Purely descriptive articles belong here. If results or processes are given they would go under 6 or 14.

22 (Foundry Practice & Appliances). This is self-explanatory.

23 (Furnaces & Fuels). This takes in descriptive articles. Otherwise they go under 10, heat treating, 10b, annealing, etc.

24 (Refractories & Furnace Materials). This section is hand-in-hand with 23. Furnace men should read both of them.

25 (Gases in Metals). This is self-explanatory.

26 (Inspection). This includes articles dealing with inspection, pure and simple—not X-ray or microscopic analysis.

27 (Effects of Elements on Metals and Alloys). Articles dealing with the effect of the addition of different chemical elements to metals and alloys are included in this group.

28 (Instruments & Controllers). Descriptive.

29 (Effect of Temperature on Metals and Alloys). This section is prepared in conjunction with the Joint High Temperature Committee of the A. S. T. M. and the A. S. M. E.

30 (Leaching). Self-explanatory.

31 (Reduction Metallurgy). This would include articles on blast furnace practice.

32 (Non-metallic Coatings for Metals and Alloys). Articles discussing painting, enameling, lacquering, etc., belong here.

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It has been our purpose in this outline to make our scheme of classification apparent to our readers and so, perhaps, make the abstract section more useful. If you have any questions pertaining in any way to the abstracts, write to us. We shall be glad to answer them in detail.

The classification number at the end of each abstract will be of assistance in mounting them on file cards.

Negative print photostats of the original articles abstracted below can be obtained at 35 cents per page, plus 10 cents for mailing first class. The remittance should accompany the order.

(See back cover)

GENERAL (0)

Alloy Steels. Robert Hunter. *Transactions Institution Engineers and Shipbuilders in Scotland*, Vol. 72, Yearbook 1929, pages 696–703.
A discussion of alloys now available. WHB(0)

The Story of Steel. J. Henderson. *South African Mining & Engineering Journal*, Vol. 42, Part 1, Apr. 4, 1931, pages 141–142; May 2, 1931, pages 245–246; May 9, 1931, pages 263–264.
General. AHE(0)

Structural Steel Research. Fred Grove-Palmer. *Iron & Steel Industry & British Foundryman*, Vol. 4, June 1931, pages 299–301.
Describes program for research. CHL(0)

21st Report of the German Atomic Weight Commission. (XI. Bericht der Deutschen Atomgewichts-Kommission.) M. Bodenstein, O. Hahn, O. Hönigschmid & R. J. Meyer. *Berichte der Deutschen Chemischen Gesellschaft*, Vol. 64, Jan. 7, 1931, pages 1–21.
Contains 43 references. The 1931 table of atomic weights is presented and atomic weight determinations made by chemical means during the past year of Ca, Tl, As, Ta, S, Cr, Cl and Re are described. The status of isotope studies is discussed and mass spectroscopic results are given for Kr, Xe, Hg, Cr, Mo, O, N, Cl and Pb. The question of finding stable elements between U and Pb is discussed. A table of isotopes is given. CEM(0)

The Education of a Metallurgist. Harold Carpenter. *Journal Institute of Metals*, Vol. 47, Mar. 1931, pages 3–9.
Review of the aims and systems for training a metallurgist in different countries. The author stresses the point that the college course should, pre-eminently, teach scientific methods because he sees in this the basis of the cultural and intellectual activity of the modern world. Ha(0)

Value of Specifications in the Manufacture of Steel. J. Brunner (Illinois Steel Company). *Preprint, Symposium on Economic Significance of Specifications for Materials, American Society for Testing Materials*, **1931, pages 7–10.**
General discussion of principles governing framing of specifications for steel, their advantages and limitations. HWG(0)

The Effect of the Development of Non-Ferrous Alloys on Iron and Steel. Maria L. V. Gaylor. *Journal Institute of Metals*, Vol. 47, Aug. 1931, pages 1–5.
The very close relationship existing between ferrous and non-ferrous alloys with regard to their development through scientific method is noted; the same fundamental problems are present in both cases; the difference is only in degree. The researches carried out on non-ferrous alloys made from as pure a material as possible have led to investigations with pure Fe and its alloys. The development of the high-frequency induction furnace has especially contributed to the production of pure metals by the possibility of melting in a vacuum. Ha(0)

Specifications from the Standpoint of a Large Purchaser of Engineering and Special Materials. J. W. Bancker (Western Electric Company). *Preprint, Symposium on Economic Significance of Specifications for Materials, American Society for Testing Materials*, 1931, pages 35–43.
Cites value of control of purchases by specification. The tool steel industry furnishes the worst example of the degree of confusion and duplication which a multitude of trade names can cause. However, until recently it was impossible to differentiate good and bad tool steels by routine inspection methods so that the standardization is difficult. No suitable inspection tests are known for welding rod. The domestic screw machine steel industry was given impetus by its effort to meet specifications imposed. Some other metallic products are mentioned in the paper. HWG(0)

In Behalf of a Standard Non-Ferrous Classification. Geo. S. Brady. *Product Engineering*, Vol. 2, Oct. 1931, pages 433–436.
There is a real need for a classification of non-ferrous alloys in a manner in which the engineer, foundryman, mechanic and purchasing agent may be enabled to compare qualities which are expected in alloys. The great number of mixtures with names which are often meaningless render such a basis of comparison impossible at present. While the S.A.E. and the A.S.-T.M. have established certain standards, they are not generally accepted or even widely known. Class names for each group of alloys are suggested, as well as a standard system to designate the contents or grade of the alloy. Standardization should allow a reasonable number of commercial alloys in each of the great groups: the alloys of Al, Cu-Ni alloys, Pb and Sn white alloys and the brasses and bronzes. Ha(0)

Progress in the Properties and Treatment of Metallic Alloys. (Quelques progrès importants dans les propriétés et les traitements des alliages métalliques.) L. Guillet. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 507–523.
Résumé of progress in the last half-dozen years. Steels containing high Cu, or Cu and Cr, steels for resistance to creep at high temperatures, (especially one of 0.30% C, 2.78% Ni, 0.75% Cr, 0.33% Mo), cast Ni-Cr steel, high speed steel with 5% Co and 0.75% Mo beside the usual constituents, use of Ni, Cr and Mo in cast iron, of heat-treated cast iron, of aluminum brasses, nickel brasses, Monel metal, strong Al alloys, Alclad, beryllium steel and of nitrided steels, are cited as important advances. HWG(0)

Text Book on General Mechanical Technology of the Metals. (Lehrbuch der allgemeinen mechanischen Technologie der Metalle.) 6th Edition. Hermann Meyer. Max Jänecke, Leipzig, 1931. Paper, $5^1/_2 \times 8^1/_2$ inches, 332 pages. Price 7.20 RM.
The methods of melting and working the alloys used in machine construction are described briefly but clearly, with the aid of many well-chosen illustrations. The book differs from many textbooks of wide scope in that it is quite up to date. Conveyor systems for continuous molding and pouring in the foundry, the Brackelsberg furnace and nitriding receive mention, for example.
While the space allotted to any one subject prevents going into great detail so that the expert in one field will not find details new to him, yet the avoidance of too great detail gives a better broad picture to the student. Casting, forging, rolling, drawing, stamping, spinning, welding, soldering and heat-treatment are discussed.
Heat-treatment receives rather too little space for correct balance, but in general, the processes are adequately dealt with, for a book of this type.
While the subject is "mechanical metallurgy," physical metallurgy is dealt with as a necessary side issue. While such references are not extensive, they are good as far as they go. The micrographs are of a high order of excellence, as are the paper and printing. There is an index.
This is a good textbook.—H. W. Gillett(0)-**B-**

World Development in Electro Metallurgy. (Le dévelopment mondial de l'électrosidérugia.) R. Sevin. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 247–255.
Brief general discussion of status of electric steel melting in various countries with still briefer comment on electric heat-treatment. HWG(0)

PROPERTIES OF METALS (1)

Magnesium and Beryllium. William Crawford Hirsch. *Electrical Manufacturing*, Vol. 8, Aug. 1931, pages 24–25.
Mg, one third lighter than Al, has been produced commercially for the last 15 years. It has enjoyed a progressive price decline. The pure metal is used chiefly as a deoxidizer and for alloys, also used to degasify radio and other vacuum tubes. Mg ribbon is used to form magnesium oxide coatings on electrical resistor elements. Mg base alloys offer much where light weight and electrical efficiency must be supplemented by mechanical strength. It is available as ingot, rod, tubing, sheet, extruded forms, wire ribbon and powder. Be is also a light metal, but so far is only in its development stages, 98% pure metal now being quoted at $145.00 a pound. Experiment shows that it has definitely assured a place in the roster of electrical materials of the near future. Beryl, the ore, is colorless and clear like glass. Be promises to be valuable as an ingredient in ferrous as well as Cu alloys. When added to Cu in minute quantities Be improves its mechanical properties without affecting the conductivity. It gives a Cu alloy a golden color. Be occurs in more than a dozen different minerals. WAT(1)

Revision of the Atomic Weight of Thallium. Analysis of Thallo-Bromide. (Revision des Atomgewichts von Thallium; Analyse des Thallobromides.) O. Hoenigschmid & H. Striebel. *Zeitschrift für anorganische und allgemeine chemie*, Vol. 194, No. 2/3, 1930, pages 293–298.
The atomic weight of Tl was found, in agreement with a previous determination of Hoenigschmid, to be 204.390 ± 0.008. Ha(1)

Electric and Magnetic Properties of Metals. (Elektrische und magnetische Eigenschaften der Metalle.) R. Becker. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.-Sept. 1931, pages 403–414.
The name "metal" designates a certain definite group of substances which are, however, characterized by properties which differ in accordance with the purpose for which they are used. For instance, the chemist, the electrical engineer and the mechanical engineer each define them according to their specific needs. The author tries to find a generally acceptable definition from the view point of the physicist; he also tries to make it possible to derive from this definition all the properties utilized by the others. Although the electron theory supplies a very satisfactory explanation of the substance of a metal, it has not so far been possible to explain some essential characteristics of a metal; for instance, its technological properties. The author particularly discusses the explanation of electrical and magnetic properties by the authors, Drude, Richardson, Bohr, P. Weiss, the final elucidation by Sommerfeld by applying the Pauli rule and the Fermi statistics. The theory of the free atoms and their distributions and the spin of the electron are explained. By this, a certain momentum is attributed to each atom besides its charge and mass and is responsible for the magnetic properties. A list of references supplements the paper. In an appendix, it is shown how the entropy of a system can be calculated from the formulas representing the Fermi distribution of the free atoms in a metal at the absolute zero point of temperature. Ha(1)

The Present State of Our Knowledge of Super-Conductors. (L'état actuel de nos connaissances sur les supraconducteurs.) A. Boutaric. *Revue générale d'Électricité*, Vol. 28, Aug. 2, 1930, pages 165–172.
The author reviews the work done since Kamerlingh-Onnes discovered, in 1911, that the electrical resistance of metals approaches zero at zero (absolute) temperature. He discusses the different theories which explain this phenomenon. The super-conductivity has, so far, been found only for the following metals; the temperature given is that at which the transition from ordinary to super-conductivity occurs (in ° Kelvin):

Lead	7.2° K.	Tin	3.2° K.
Mercury	4.2° K.	Thallium	2.47° K.
Indium	3.4° K.	Gallium	1.07° K.

The crystalline condition and elastic deformation have considerable influence on the super-conductivity. The table of Kapitza is given for a number of metals. The theory of Riecke and Drude is accepted, to-day, as the most probable explanation of the phenomenon. 16 references. Ha(1)

Handbook of Inorganic Chemistry. Vol. 4. Section 3, Part 2A, No. 1. **Iron and Its Compounds. (Handbuch der anorganischen Chemie.** Vierter Band, dritte Abteilung, zweiter Teil, A, Lieferung 1. **Eisen und seine Verbindung.)** Abegg, Auerbach & Koppel. Verlag S. Hirzel, Leipzig, 1931. Paper, 7 × 10 inches, 336 pages. Price 40 RM.
The topics covered are, atomic weight, J. Meyer; the iron atom, E. Rabinowitsch; preparation of pure iron and its physical properties, K. Fishbeck; pyrophoric and colloidal iron, D. Deutsch; electromotive and electrochemical behavior, H. Danneel. The next volume is to deal with passivity, corrosion, compounds with metalloids and alloys with metals, and the history and occurrence of iron. Though this volume is in a chemical series, it deals almost wholly with the physical properties of iron, of which the magnetic properties are most fully described, 380 literature references being cited.
There being no truly pure iron, only those physical constants are really established which are not materially affected by the impurities of so-called pure iron. In other cases, a process of extrapolation may give a fair approximation, but in a great number all that can be done is to cite the composition of the material studied, insofar as it was determined, and the data obtained on the various samples for the constant in question. The tabulated or plotted data of various workers often show huge variations. The density of a given sample of α-iron at room temperature can be determined precisely to several places of decimals, but that of pure iron cannot be precisely stated to more than one place, i. e., 7.9. The Brinell hardness of pure annealed iron is not known, as figures for so-called pure iron run from 50 to 80. Data for specific heat of molten iron at 1600° C. vary from 0.15 to 0.23. The heat of transformation of β- to γ-iron is given from 2.9 to 6.7. The heat of fusion may be anything from 50 to 70, according to the data one cares to accept.
This state of affairs makes it necessary for all determinations to be accompanied by a statement of the analysis of the material. While it is not very clearly brought out in this volume of Abegg, even that does not fully define the material since the oxygen content of most so-called pure iron samples used in the various investigations has not been determined, and it varies greatly, often being much larger in amount than that of some of the impurities that are determined. The subject thus resolves itself into a discussion of the effect of impurities, particularly carbon, on the various constants, and this is quite well covered.
The editor and his collaborators have painstakingly collected the available data, citing the analysis of the material studied insofar as it is known and have excluded some obviously erroneous data. With all the exercise of their critical faculties, they are seldom able to fix a reliable figure for a constant, without uncertainties of a rather large order of magnitude.
The volume is of great value, not only in presenting data, but in showing their discordance, and the pressing need for the preparation of truly pure iron on a scale sufficient to afford material for the obtaining of data of greater reliability.
That so important a metal as iron is such a stranger in pure form is a challenge to metallurgy that should not go unheeded. The book makes this challenge clear.
While there is a table of contents, there is no index, which seems inexcusable in a reference book of this type.—HWG(1)-**B-**

PROPERTIES OF NON-FERROUS ALLOYS (2)

A Few Mechanical-Technical Properties of the Red Brass Alloys Rg 10. (Zur Kenntnis einiger mechanisch-technischer Eigenschaften der Rotgusslegierungen Rg 10.) WILLI CLAUS. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 3, 1931, pages 283–285.

Analysis and test results are given and the influence of impurities determined. The tensile strength of this alloy is 20 kg./mm.^{2}, elongation 10%, Brinell hardness 65 kg./mm.^{2}, and bending number 15. Other tables give the properties of this brass if alloyed with Pb and Sb. Ha(2)

Casting Studies on Light Aluminum Alloys. Influence of the Chemical Composition. (Étude de la coulée des alliages légers d'aluminium. Influences de la composition chimique.) ANDRÉ COURTY. *Comptes Rendus*, Vol. 191, Dec. 8, 1930, pages 1128–1130.

Al-Si, Al-Cu and Al-Zn alloys of varying composition were examined by a method described previously. The following conclusions were arrived at: In determining the casting qualities, it is necessary to consider the density of the metal as well as its composition. In the light Al alloys investigated, the "castability" diminishes, within the proximity of the range of pure metal, with an increase of metals in solid solution. In the Al-Si alloys, in spite of the rapid elevation of the fusion point and the distinct decrease in the density, the "castability" was found to be superior in the high-Si alloys (up to 21.72% Si) as compared with the eutectic (13% Si). In the Al-Cu alloys, the alloy of 6% Cu has the "castability" of Al and the alloy of 12% Cu surpasses the "castability" of pure Al by 20%. Within the large zone of the solid solution diagram of the Al-Zn alloys, the "castability" is diminished with an increase in Zn in spite of the rapid increase of the density. It requires 30% Zn to obtain an alloy of the "castability" of pure Al. (2)

Iron-Brasses and Magnesium Brasses. (Les laitons au fer et les laitons au magnésium). L. GUILLET. *Cuivre et Laiton*, Vol. 4, July 15, 1931, pages 303–304.

Brief report of tests shows that the addition of Fe to brass, even up to 1.6% does not produce any important new property. The addition of Mg of less than 0.3% is of no importance but, in larger amounts, it exerts an extremely harmful influence on the mechanical properties. Ha(2)

Precious Metal Alloys. R. C. BRUMFIELD (Cooper Union). *American Society for Steel Treating, Preprint* No. 28, 1931, 22 pages; *Mining Journal*, Vol. 175, Oct. 31, 1931, page 820; Nov. 7, 1931, pages 835–836; Nov. 14, 1931, pages 852–853.

Paper read and discussed before the Boston Convention of the Society in Sept., 1931. The author describes the properties of certain noble metal alloys used mostly for dental purposes. The heat treatment possibilities of increasing the hardness, the workability, the melting points and casting properties are discussed. 22 references. WLC(2)

The Complex Brasses. (Les laitons complexes.) LÉON GUILLET. *Cuivre et Laiton*, Vol. 4, Sept. 15, 1931, pages 399–400.

When adding a metal to another metal, it should go into solution completely; if it keeps its character, it may form injurious constituents. The author shows the manner in which the valency can be used to learn the proportions in which additions should be made to brasses to be sure to obtain real solutions of definite uniform properties. Ha(2)

Production and Application of Light Metals and Alloys in Italy. (Production et application des métaux légers et de leurs alliages en Italie.) A. W. BONARETTI. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 903–911.

A general survey. See *Metals & Alloys* Vol. 2, Nov. 1931, page 275. HWG(2)

Non-Ferrous Alloys. L. E. ABBOTT. *Bell Laboratories Record*, Vol. 10, Sept. 1931, pages 13–16.

A general discussion on the importance of non-ferrous alloys, their characteristics and testing, and work done in the Bell Laboratories. Ha(2)

Beryllium and Beryllium Bronzes. (Le glucinium et les bronzes au glucinium.) JOH. BECKER. *Revue Fonderie Moderne*, Vol. 25, Sept. 25, 1931, pages 343–344.

Brief survey of the recently developed Be alloys and their qualities. Pure Be has a density of 1.85, a melting point of 1285° C., is hard to work and costs about 18 francs/g. Technical Be is about 98% pure with about 1% Fe and the remainder of other impurities; price about 5.40 francs/g. Alloys of 80% Be with 20% Fe or Ni are made electrolytically. The beryllium bronzes are refinable by heat treatment; their electric conductivity is twice that of aluminum bronzes or phosphor bronzes. They possess an extraordinary elasticity and are, therefore, used for springs which are under permanent fatigue stresses. Bronzes with 1–2% Be are also very useful for pieces subject to great wear. The study of beryllium alloys has only begun. Ha(2)

Thermal Conductivity, Electrical Conductivity and Lorenz's Coefficient of Some Light-Metal Alloys. (Wärmeleitvermögen, elektrisches Leitvermögen und Lorenzsche Zahl einiger Leichtmetall-Legierungen.) W. MANNCHEN. *Zeitschrift für Metallkunde*, Vol. 23, July 1931, pages 193–196.

The present investigation on thermal and electric conductivity and of the Lorenz coefficient determined on Al and Mg-alloys cover the temperature range from −190° to +200° C. The thermal conductivity λ of light metals is materially cut down by the addition of other elements which effect proved to be more pronounced at low temperatures than at elevated ones. Therefore, the temperature coefficient always yielded a positive value in case of light metal alloys in contrast with pure light metals. Heat-treatment resulted in appreciable changes but further experiments are urged to confirm the present deviations. Similar to the data gained on thermal conductivity measurements were the results from the electrical conductivity (H) determinations. By alloying Si and Mn to Mg, values on electrical conductivity were obtained which are evidently not in agreement with conclusions drawn from the constitutional diagrams. The Lorenz coefficient $\frac{\lambda}{H\,T}$ has been computed and is larger in case of alloys than in case of pure metals. However, attention is called to some deviating results gained on Cu-Al, Mn-Mg and other alloys. EF(2)

The Mechanical Properties of Ultra Light Alloys. (Die statischen Eigenschaften der Ultra-Leichtlegierungen.) N. PARRAVANO & G. GUZZONI. *Metallwirtschaft*, Vol. 20, May 22, 1931, pages 410–414.

Contains 14 references. The practical importance of the elastic limit and yield point rather than ultimate tensile strength of metals is pointed out. See "Static Properties of Ultra Light Alloys," *Metals & Alloys*, Vol. 1, Aug. 1930, page 689. CEM(2)

Recent Research on 18-Carat Gold. ERNEST A. SMITH. *Metal Industry*, London, Vol. 39, Aug. 7, 1931, pages 123–125; Aug. 21, 1931, pages 183–184.

Six references. Color, melting points, solidification ranges, tensile and hardness values and results of Erichsen tests are listed for alloys containing 75% Au, the remainder being Ag and Cu. Mention is also made of the effect of annealing temperature and time and influence of furnace atmosphere especially on Cu rich alloys. PRK(2)

The Noble Metal Alloys and Amalgams in Dentistry. (Edelmetallegierungen und Amalgame in der Zahnheilkunde.) LUDWIG STERNER-RAINER. Hermann Meusser, Berlin, 1930. Cloth, 6 x 9 inches, 111 pages. Price 10 RM.

This book is written largely from the standpoint of the investigator or testing engineer. The work on the noble metals appears to be based mostly upon the author's own researches.

Pages 1 to 27 are devoted to general discussions of the properties of metals, including crystal structure, physical properties and alloy systems.

Pages 28 to 69 are devoted to the properties of gold, silver, copper, platinum, radium, palladium and their alloys. The ternary systems, gold-silver-copper, are discussed with reference to the melting point, toughness, tensile strength, and hardness. Gold alloys of different karats are discussed, composition and physical properties being given in tables. Tables of 92 gold alloys are given with chemical composition, physical properties, liquidus and solidus points. More attention has been given to the physical properties of these alloys than is usually found in a publication of this type.

There is considerable attention given to the effect of heat treatment on the physical properties of the alloys, and some information is given with reference to the various uses of the alloys in the dental profession.

There is a lack of microphotographs, although some of the structures are illustrated by drawings, probably produced by the aid of such equipment as the camera lucida.

Gold solders are included in this discussion of the noble metal alloys.

Pages 70 to 111 are devoted to the discussion of amalgams. In this section of the book the author seems to have depended to a larger extent upon information in the literature. The first few pages are rather historical in character. In the latter part of the section on amalgams, the author has again given a considerable amount of the results of his own investigation. Such subjects as volume changes, crushing strength, hardness, effect of mercury—alloy ratio, and corrosion are discussed with diagrams and tables.

American investigations on amalgams have not been included.

American students in this field will find some additional data in this book and will find some references to European researches, more particularly German investigations.—O. E. Harder (2)-B-

Technology and Use of Electron Metal. (Technologie und Anwendung des Elektronmetalls.) WALTHER SCHMIDT. *Elektrochemische Zeitschrift*, Vol. 37, Aug.-Sept. 1931, pages 508–517.

A tabulation of cast and extruded Mg alloys with Al, Zn, Mn and Si containing at least 90% Mg. Technological properties are given with their possible fields of application. The production and refining, corrosion and danger of burning, machining by different processes and possible savings in weight are discussed. Illustrations show a few examples of designs with electron metal. Ha(2)

Magnesium, Magnesium-Rich Alloys and Beryllium Alloys. T. HENRY TURNER. *Metal Industry*, London, Vol. 36, Jan. 17, 1930, pages 85–89.

Summarizes present uses of these alloys. Mg alloy castings are produced at about same price as Al castings. Percentage of scrap and rejected castings speak in favor of Mg alloys. Elektron is especially suitable for pressure die casting. Heat treating tests on Mg alloys to date give promise of improvement. Alloy castings may be machined with very heavy cuts, without distortion of metal. Considerable progress has been made in production of Mg sheets since the technique of hot working is better understood. Mg alloys require protection from certain corrosive atmospheres and liquids encountered in service. Promising developments have been made in the production of Be alloys of Cu and Ni to be used as temper alloys. These alloys are very hard and strong. Gives various uses. VSP(2)

Discontinuities at the Melting Point of Bismuth. W. L. Webster. *Proceedings Royal Society*, Vol. 133, Sept. 1931, pages 162–172.

The investigations described were undertaken to determine whether Bi, in solidifying, passed through a transitional cubic phase (a suggestion put forward by Professor Kapitza to explain the formation of cracks during the growth of Bi crystals). The experiments show that the temperature of emission of the latent heat of fusion, of the acquisition of rigidity, and of the anomalous diamagnetic discontinuity coincide within an experimental error of 0.3° C. This coincidence leaves no room for such a cubic phase, and another process, based on the self-purification of growing crystals, is suggested to account for these cracks. WAT(2)

Heat Treatment Is Indispensable for Aluminum and Its Light Alloys. (Les traitements thermiques sont indispensables a l'aluminium et aux alliages légers d'aluminium.) M. J. SUHR. *Congrès International des Mines de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 593–598.

The conductivity of Al wire depends on the time and temperature of annealing given. If behavior in the Stanton repeated impact test is a criterion of quality, proper heat-treatment may increase the quality of an Al casting alloy 50 fold or more. The heat-treatments given the different alloys are none too clearly described. See also *Metals & Alloys*, Vol. 2, May 1931, page 95. HWG (2)

The Effects of Cold-Rolling and of Heat-Treatment on Some Lead Alloys. H. WATERHOUSE & R. WILLOWS (Research Department, Woolwich). *Institute of Metals, Advance Copy* No. 584, Sept. 1931, 23 pages.

The effects of cold rolling, heat treatment and aging on the Brinell hardness of 14 Pb alloys were studied. The alloys contained small amounts (3% or less) of Cd, Sn or Sb; some contained both Sn and Cd and others contained both Sb and Cd. Cold rolling hardened the softer alloys and softened the harder alloys but, after aging at room temperature, the hardness of all of the alloys fell to 7 Brinell. Most of the alloys could be age-hardened. In certain of the alloys, the age hardening persisted for at least several months but was destroyed by further work. Certain of the alloys in the age-hardened condition were as strong as the alloy used for battery grid plates containing 5–12% Sb. Contains 15 references. JLG(2)

Metallurgical Problems in Aluminum and Aluminum Alloys. (Metallkundliche probleme bei Aluminium und Aluminiumlegierungen.) G. SACHS. *Elektrochemische Zeitschrift*, Vol. 37, Aug.-Sept. 1931, pages 436–447.

Problems in metallurgy deal, in general, with the changes of properties. 2 groups of causes for these changes are distinguished: The forming of alloys and the mechanical and thermal treatment. In this paper, the author emphasizes the properties of strength and cohesion of Al because these are the most important for the practical application of the metals. First, the results of physico-mechanical tests are described, as well as the production and properties of single aluminum crystals. For the chemical behavior of a material, its position in the vertical column of the periodic system is determining. The mechanical properties, however, seem to be based, mainly, on the lattice structure. All crystals of pure metals which crystallize in the same system possess the same crystal planes and crystal directions as sliding elements. This gives a basis for the determination of mechanical properties and the possibility of refining. 3 possibilities for increasing the strength of metals exist: (1) densifying (by compressing); (2) refining of the grain; (3) formation of solid solutions. These methods are discussed in detail and alloying by rolling and casting are described and the diagrams of state are illustrated. The nature of hardening, corroding and the formation of protective surfaces are also considered and explained in the light of the present state of knowledge. Many details are not yet satisfactorily explained, but still require extensive systematic research. 38 references supplement the article. Ha(2)

PROPERTIES OF FERROUS ALLOYS (3)

Comparative Physical Properties of Cr-Ni, Cr-Mn and Mn Steels. C. L. Clark & A. E. White. *Transactions American Society Mechanical Engineers*, Vol. 53, May–Aug. 1931, *Fuels & Steam Power*, pages 177–182.
With discussion. The paper gives the results of short-time tensile tests at 75 and 1000° F. and creep tests at 1000° F. on selected steels of the types named in the title, where Si and W are present. The tests are described and the results indicate that the substitution of Mn for Ni in Cr-Ni steels is detrimental, at least in so far as the load carrying ability of the alloy is concerned. While the creep resistance of the Mn and Mn-W steel at 1000° F. is superior to that of many pearlitic steels, it is not equal to that of Enduro KA2 type of alloy which contains only Cr and Ni. The 14% Mn steels possess properties comparable to those of the Cr-Mn steel, while the addition of W was found to increase its resistance to a marked degree. Ha(3)

The Influence of Rolling-In of Pipes on Ordinary Boiler Plate and on Izett-Plate. (Der Einfluss des Einwalzens von Röhren auf gewöhnliches Kesselblech und auf Izett-blech.) O. Bauer & H. Arndt. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 48–53.
Both kinds of plates of known mechanical and structural qualities were drilled for taking up the fire tubes and the changes that had occurred were investigated. With regard to structural conditions, the 2 plates did not show any pronounced difference. Notch-tests show the Izett-plate (Krupp) to be superior to the other plate, the notch toughness being almost the same as for the full material after the tubes had been rolled-in. Aging through annealing effects a decrease of notch-toughness in both; but the Izett-plate is greatly superior (11 mkg./cm.²) to the ordinary plates (less than 4 mkg./cm.²). Ha(3)

Workability of Killed and Rimmed Steel. (Ein Beitrag zur Frage der Verarbeitbarkeit von beruhigtem und unberuhigtem Stahl.) P. Bardenheuer & H. Wünnenberg. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 4, 1931, *Report* No. 174, pages 63–77; *Stahl und Eisen*, Vol. 51, May 21, 1931, page 651.
The effect of steel making upon workability was studied on 6 heats of about 0.1% C melted in a high frequency furnace and deoxidized and finished as follows: No. 1: Mn deoxidized, Al killed, alloyed, 0.2% Si; No. 2: Mn deoxidized, alloyed, 0.2% Si; No. 3: Mn deoxidized, killed with Si; No. 4: Si deoxidized, alloyed, 0.2% Si; No. 5: Al deoxidized, alloyed, 0.1% Al; No. 6: Mn deoxidized. The ingots were in part forged to take samples for physical tests, in part rolled to rods and subsequently drawn to wire, and in part rolled to hoops. The results of tensile tests, aging tests and comparison tests do not allow definite conclusions to be drawn as to the workability. The rolling and drawing tests indicate a better workability of the rimmed steel. The differences are, however, of a minor nature. The ingots with a rough surface could be better worked than those with smooth surface. It is noticed that the conditions of working, deformation velocity, shape of tool, lubrication and other factors have an important bearing upon the workability of steels finished by various methods. GN(3)

Strength and Wall-Thickness of Cast Iron. (Festigkeit und Wandstärke bei Gusseisen.) Paul A. Heller. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 20, 1931, pages 237–241.
The literature on relation between strength and wall-thickness is reviewed and critically discussed. The test results of different authors are compared. This comparison leads to the belief in the existence of several groups of cast iron types of equal strength relations and the probability that these relations can be represented in a diagram of strength over wall-thickness. 28 references. Ha(3)

Recent Developments in Special Iron. A. B. Everest. *Foundry Trade Journal*, Vol. 44, May 21, 1931, pages 355–358.
After discussing the metallography of cast Fe, the author deals with the limitations of the material and with methods which may be adopted to control the nature of the material during the melting operation. Recent developments in methods of manufacturing cast Fe are discussed and some attention is given to the use of alloy additions. Martensitic and austenitic irons are dealt with, and the mechanical properties of heat-treated alloy cast Fe are also noted. Space is devoted to the discussion of this paper and to the author's reply. OWE(3)

Properties and Fabrication of Stainless Steels. (Communications sur les relations entre les propriétés et la fabrication des aciers inoxydables.) E. Houdremont. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 181–199; *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Mar. 1931, pages 110–125.
Includes discussion and 47 figures. Very complete résumé of history, equilibria, melting practice, hot and cold working, weldability, recrystallization, corrosion resistance, intercrystalline attack, physical properties and structure of the Cr-Ni stainless steels. Most of the information is available elsewhere, but is conveniently collected here. Houdremont states that 18-8 can take up a "dangerous amount" of N up to 0.20% from the air on melting. This is said to be a characteristic of the steels high in Cr. See also *Metals & Alloys*, Vol. 2, Mar. 1931, page 63. HWG+GTM(3)

Recent Developments in Corrosion- and Heat-Resisting Steels. Robert Hadfield, T. G. Elliot & R. J. Sarjant. *Journal Society Chemical Industry*, Vol. 49, Jan. 24, 1930, pages 41–51.
A review of primarily Cr and Cr-Ni type steels covering their history; corrosion resistance in acid, atmosphere and sea water; mechanical and physical properties; microstructure; heat-resistance; and industrial applications. VVK(3)

Industrial Steels and Alloys—Recent Developments. Part 1. Steels for Strength, Corrosion and Machining. J. W. Donaldson. *Journal Society Chemical Industry*, Vol. 50, Sept. 25, 1931, pages 787–793.
A general review of C and alloy steels, their types and applications. VVK(3)

The Manufacture and Testing of Forging Quality Steel. N. L. Deuble. *Heat Treating & Forging*, Vol. 17, Sept. 1931, pages 864–869.
The requirements for low C steels which are to be used for forged products are discussed and methods of testing their qualities are described. Ha(3)

Cold Working Followed by Annealing. Robt. L. Geruso. *Heat Treating & Forging*, Vol. 17, Feb. 1931, pages 139–142.
A study of the effect on the physical properties of 0.22% C and 0.89% Mn steel reveals the fact that the physical properties of cold worked steel are altered by annealing at low temperature; that the ultimate strength as well as the yield point is raised, the former attaining its maximum on annealing at 300° C., while the latter attains its maximum when at 200° C. The toughness of this steel was lowered about 23% if cold working from 12 to 20% was followed by annealing from about 150° to 250° C. The notched-bar toughness is relatively high. The hardness of such cold worked steel can be increased by low-temperature annealing from 200° to 400° C. In all cases, the hardness of the steel, regardless of the amount of cold work, will be lowered on annealing above 500° C. Bend and notch-impact tests prove that the usual toughness of cold worked steel is reduced on annealing below 300° C. The critical temperatures vary according to the degree of cold working. Ha(3)

New Permalloys. G. W. Elmen. *Bell Laboratories Record*, Vol. 10, Sept. 1931, pages 2–5.
Permalloy containing 78.5% Ni and 21.5% Fe was tested to increase its usefulness in alternating current circuits by giving it a higher resistivity and also to simplify its heat treatment. The addition of either Cr or Mo accomplished the first purpose and also tends to increase the initial permeability. The addition of 3–5% caused an appreciable effect in this direction. Characteristic curves and data on heat treatment and Curie point (at which the material becomes nonmagnetic) are given. Permalloy is particularly useful in telephone circuits and instruments. Ha(3)

Some Physical Properties of High Speed Steel. Joseph V. Emmons (Cleveland Twist Drill Co.). *American Society for Steel Treating, Preprint* No. 22, 1931, 30 pages.
Paper to be read and discussed before the Boston Convention of the Society in Sept. 1931. 8 references are made to the literature and the paper is illustrated by numerous graphs and micrographs of high speed steel structures. The study of the common 18-4-1 type of high speed steel reported shows a measurable plasticity in hardened high speed steel at all heat treatments which appears to be governed largely by the troostite content of the structure. Martensite contributes high strength to which a small amount of troostite and accompanying plasticity gives better distribution of stresses. Variations in the amount of carbide taken into solution results in 3 types of martensite: low C type reverting to troostite at low drawing temperatures; high C content type decomposed only at high drawing temperatures; secondary martensite resulting from the decomposition of austenite on drawing. The indefinite property of toughness is analyzed and evaluated numerically. Martensite gives the hardness which is decreased by the presence of austenite and troostite. WLC(3)

Properties of Hardened Tool Steel. J. V. Emmons. *Heat Treating & Forging*, Vol. 17, Sept. 1931, pages 880–882; Oct. 1931, pages 961–964.
A detailed story of tests of tool steel with regard to hardness, toughness, tensile strength and torsional strength. 14 references. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 205. Ha(3)

"Migra-Iron," a New Special Pig Iron for High Quality Casting. (Ueber "Migra-Eisen," ein neues Specialroheisen für hochwertigen Guss.) E. Piwowarsky & A. Wirtz. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Sept. 4, 1931, pages 703–705.
Migra iron is obtained from iron by the usual melting in the blast furnace but which, before casting into pigs, is subject to a special heat treatment in large refining tanks. This heat treatment consists of an overheating of definite duration and temperature and results in a remarkable fine grain and formation of graphite from which the name Migra (micro-graphite) is taken. This iron is used where a high machinability, easy pouring and high density is required with simultaneously good mechanical properties. It can also be used instead of charcoal pig iron for chill casting, roll castings and ingot molds. Microphotographs illustrate the difference in structures at the different stages of treatment. Ha(3)

A Few Recent Advancements in Tool Steels. (Einige Neuerungen auf dem Gebeite der Werkzeugstähle.) F. Rapatz. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, July 25, 1931, pages 965–968.
The conceptions of hardness and toughness are explained and an investigation made to note the way in which these properties can be determined numerically. Their dependence on the C contents and temperature is shown in curves and the progress made illustrated on tools for cold impact, cold drawing, threading, hot working tools, high speed tools and cutting metals. Ha(3)

On the Distribution of the Tensile Properties in Rolled Steel Shapes. (Ueber die Verteilung der Festigkeitseigenschaften in gewalzten Stahlprofilen.) F. Sauerwald, E. Seemann, F. Rögner & H. Müller. *Archiv für Eisenhüttenwesen*, Vol. 4, Mar. 1931, pages 431–434; *Stahl und Eisen*, Vol. 51, Apr. 30, 1931, pages 554–555.
Differences of the properties in various parts of a steel section may be due to (1) non-uniform composition of the material; (2) inner stresses; (3) non-uniformly distributed strain hardening; (4) non-uniform structure. The authors tested rails, T, double T and U shapes. The tensile strength was found to be higher in the web than in the other parts. Also the hardness is generally the highest in the web. In testing the rails, larger fluctuations of the hardness were observed in the web than in the head and the foot. The parts of the web close to head and foot showed a higher hardness than the middle of the web. There were only a few segregations in the rails tested but pronounced segregations in the other shapes tested. The outer zones of rounds and squares are softer than the core. The hardness generally decreases in heating to 600°, 770° and 780° C. In heating rails, the hardness of the web decreases more than that of head and foot. The results on the rails indicate that the differences of the properties are due to a non-uniform strain hardening but in the other shapes they are due to variations of the composition. The distribution of hardness of cold worked and recrystallized rounds was also studied. GN(3)

The Mechanical Properties of Open Hearth and Bessemer Steel Rails. (Die mechanischen Eigenschaften von Siemens-Martin- und Bessemer-Stahlschienen.) W. N. Swetschnikoff. *Stahl und Eisen*, Vol. 51, Aug. 20, 1931, pages 1065–1066.
Abstract of a paper by the same author in *Ugoli i Jeleso*, 1930, pages 60–67. The results of this statistical research indicate that Bessemer rails have a higher tensile strength, limit of elasticity and limit of proportionality, and, in part, also a higher elongation than open-hearth rails. The differences are due to the production methods and, therefore, due to the chemical composition. Bessemer rails are made of steel containing 0.10%–0.15% less C than open hearth rails; but the P and N_2 content is higher. GN(3)

Rustproof, Austenitic Materials for Nozzles of Steam Turbines. (Rostfreie austenitische Schaufelwerkstoffe für Dampfturbinen.) H. Schottky & E. Houdremont. *Krupp'sche Monatshefte*, Vol. 12, July 1931, pages 188–194.
After a short historical review of the development of austenitic steels, the Ni steel type V5M was developed. This steel not only possesses the required strength and hardness, but also good workability; its analysis is 0.1–0.15% C, 12% Cr, 0.7% Ni. It has a tensile strength of 70 kg./mm.², elastic limit of 48 kg./mm.², bending vibration strength of 36 kg./mm.² 2 other types of steel, WF100 and NCT4, have been developed (but not yet used) and promise very well for use, particularly as nozzle material. 8 references. Ha(3)

Chromium Iron Alloys Have Remarkable Properties. Charles A. Scharschu (Allegheny Steel Co.). *Metal Progress*, Vol. 20, July 1931, pages 59–63.
Continuation of article appearing in May issue discusses the fabrication, welding, drawing, pressing and applications of low carbon chromium iron alloys. WLC(3)

Stainless Steel and Its Properties. Earl Smith. *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1403–1405, 1408.
The physical and chemical characteristics of this steel are fully described and its treatment, according to the purpose for which it is intended, is discussed. The properly treated Cr-Ni-irons are austenitic, non-magnetic and single phase solid solutions. By cold working, they become magnetic. Ha(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Losses from the Corrosion of Underground Piping. E. R. SHEPARD. *Gas Age Record*, Vol. 68, Sept. 5, 1931, pages 333, 350.

Any attempt to estimate the annual loss from corrosion of underground piping systems is obviously a speculative enterprise. The round figure of one hundred million dollars which has been named at various times as the annual loss from corrosion to the petroleum industry, which amounts roughly to one cent/gal. of gasoline produced, is based on a summary of replies to the American Petroleum Institute corrosion committee questionnaire, as prepared by F. N. Speller and E. L. Chappell in 1927. These figures include corrosion on production, transportation and refining equipment, but apply only to the petroleum industry. For the pipe lines alone, an average annual loss from corrosion of \$308/mi./yr. was arrived at. The pipe line maps published in the *Oil & Gas Journal*, June 4, 1931, show approximately 109,800 mi. of trunk and gathering lines used for the transportation of oil and gasoline, and approximately 65,000 miles of natural gas pipe lines in the United States. An average figure of \$7000/mi. a normal cost for an 8-inch oil line, will be employed in this estimate. The average size of natural gas lines is something larger than that of oil lines, and a unit cost of \$12,000/mi. will be used for these lines. Many of the larger lines cost more than double that amount. Using the above unit costs and lengths, we have the following summary of values:

109,800 mi. of oil and gas lines at \$7000	\$768,600,000
65,000 mi. of natural gas lines at \$12,000	780,000,000
138,000 mi. of gas distributing mains at \$15,000	2,070,000,000
138,000 mi. of water distributing mains at \$15,000	2,070,000,000
Total	\$5,688,600,000

It requires an annual depreciation of only 2.5% to arrive at a figure of \$142,-215,000 as the annual loss to underground piping systems chargeable to soil corrosion. This value for depreciation, which represents an average life of 40 yrs., is in line with Speller's value of \$308/mi./yr., which is approximately 3% on a valuation of \$10,000/mi. This figure is obviously too high for some cases, but too low for other cases. Cast iron mains in cities will last longer than 40 yrs., while many other types of pipe lines must be serviced or replaced after a period of 10 to 30 yrs. To this must be added the value of lost oil and gas, damage to crops and other property, interruption of service, and other expenses incidental to corrosion damage. Approximately \$50,000 is expended annually by the Bureau of Standards, the American Petroleum Institute, the American Gas Association, and the Cast Iron Pipe Research Association, for a scientific study of the corrosion problem and methods of prevention. This is but slightly more than 1/30 of 1% of the estimated annual corrosion loss to the piping systems of the country. WAT(4)

Value of Cadmium as a Corrosion Preventative for Copper, Brass and Bronze. GUSTAF SODERBERG. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1017–1022.

Cd alloys with brass, especially high Zn brass, and with bronze at ordinary room temperatures. Cu and Cd alloy only at temperatures above 212° F. Coatings less than .00005 in. thick are absorbed by brass in a couple of months. Electrochemical protection of Cu and its alloys by Cd is more pronounced than the same protection of steel. Corrosion resistance of Cd plating increases approximately with the square of the thickness of the plate. Thickness of 0.00015 in. is a minimum on Fe and steel for satisfactory rust resistances. Standards require 0.0002 in. on steel for normal conditions and as high as 0.0004 in. for severe conditions. Army specifications call for 0.0003 in. Cd. In the case of Cu and its alloys, these figures should be increased 50% for equal protection. Improper cleaning is responsible for about 95% of the troubles in plating. Special mild cleaners developed for Cu, brass and bronze should be used. Temperature should be 180–200° F. and the current density, 40–50 amp./ft.^{2}. Tarnish is removed in a 50:50 HCl dip. For removal of black oxide scale, 5–10% H_2SO_4 is used. This is used cold on yellow brass, but the temperature may be 150° F. in pickling brass containing less than 20% Zn. Red spots of Cu_2O may be removed by HNO_3. Recommends bright dipping in a solution containing in 25 gals. H_2SO_4, 11 gal., HNO_3, 2 gal., HCl, 1 pt., H_2O, 12 gal. Cd-plated brass parts of electrical apparatus often become rapidly covered with a non-adherent white powder on exposure to a tropical climate. This corrosion product consists of water-soluble organic matter and is due to the presence of unsuitable electrical insulating materials. Cd plating of both brass and steel when these come in contact will prevent electrolysis. There is practically no action between hot-dipped Zn and Cd. Electrical resistance of Cu contacts increases greatly when the Cu is oxidized. Cu oxidizes readily at room temperatures, but Cd does not oxidize below 480° F. Also, electrical resistance of CdO is much less than that of CuO. Tests have shown that Cd plating of contacts operating under oxidizing conditions reduces the contact resistance. Parts which are not subjected to oxidation and which must operate within very small temperature intervals should not be Cd plated. MS(4)

The Behavior of Heat-Resistant Alloys toward Sulphur. (**Ueber das Verhalten hitzebeständiger Legierungen gegen Schwefel.**) A. SCHULZE. *Die Wärme*, Vol 53, Aug. 30, 1930, pages 662–663.

A report of the work of H. Gruber ("Anniversary of the seventieth birthday" of W. Heraeus, Hanau, 1930, page 45) on corrosion resistance of alloys to H_2S at high temperatures. The alloys studied were Cr-Fe, Cr-Ni-Fe, Cr-Ni, Cr-Ni-Mn, Al-Ni-Cr, Mn-Fe, Al-Ni, Al-Fe and Al-Cr-Fe at temperatures of 700–1000° C. The aluminum alloys showed the least attack. WHB(4)

Effect of Adding Colloids to Electrolytic Solutions for Preparing the Anodic Film on Aluminum. S. SATOH & A. MIYATA. *Scientific Papers Institute Physical & Chemical Research*, Tokyo, Supplement, Vol. 15, Dec. 24, 1930, 6 pages; *Journal Society Chemical Industry*, Vol. 50, April 17, 1931, page 352.

The electrolytic formation of protective films of oxide on an aluminum anode in 2% oxalic acid and also in 3% chromic acid has been studied. The addition of sodium silicate increases the anode potential and decreases the scratch-hardness of the film produced. The film obtained in the presence of sodium silicate is also less resistant to corrosion than that produced in its absence. WHB(4)

Corrosion Tests in Germany. GEORGE BOLDBACH. *Aircraft Engineering*, British, Vol. 3, Aug. 1931, pages 195–196.

Tentative standard methods laid down by the Aluminum Board of the Reichsauschuss für Metallschutz. In all corrosion tests, it should be noticed carefully that both the material and the attacking agent conform fully to service conditions. The chemical composition, the mechanical properties, and the previous treatment of the test material should be stated as far as possible. At least 3 specimens should be tested at once rather than each at different times. In order to compensate for unevenness, the area should be as large as possible. The specimens should be cleaned with light benzine or pure benzol or a mixture of both. Ether, acetone and the like should not be used on account of the cold produced by vaporization. The specimens should not be bored if it can be avoided, as the area of attack is increased. Cut edges should not be covered, for in severe attack the covering may be undermined and removed and the test unreliable. The points to be noted when testing the corrodibility are: (1) changes in the surface, (2) changes in the microstructure, (3) loss in weight, (4) changes in the mechanical properties, (5) nature and condition of the corrosion products. In total immersion tests the solution should be stirred. For Al and its alloys, a solution of 0.5 *N* (about 3%) sodium chloride and 0.1% hydrogen peroxide is recommended. This 0.1% hydrogen peroxide content should be kept up by suitable additions once a day. In alternate immersion tests the attacking agent should be chosen so that at least 6 cc. of the solution corresponds to 1 cm.^{2} of the submerged area. Salt spray tests are usually made in diffused daylight and with 0.5 N sodium chloride (about 3%). Weather exposure tests are made by use of adequate wooden frames, precautions being taken that no stains are produced on the samples. The frames should be erected facing south at an angle of 45° and be at least 50 cm. above ground. In all cases, care should be exercised that the suspension and insulation of the specimens conform to service conditions. The duration of tests should be in accordance with extent of the corrosive attack. WAT(4)

Metal-Corrosion Problems—The Stability of Thin Films. U. R. EVANS. *Chemical Trade Journal*, Vol. 89, Sept. 18, 1931, page 270.

Oxide films on metals are removed, almost generally, by dissolving th metal immediately below. The movement of electrode potential with time provides a valuable method of determining whether weak spots in natural oxide films are healing up or are extending. The method has been applied to show the self-healing qualities of the film present on the new Al-containing brass used for condenser tubes, also to the comparison of various steels containing Cr and/or Ni under different conditions of heat treatment and surface treatment. Influences destructive to protective films include "screening" from O, continual bending or abrasion or bombarding by air bubbles. Alternating stresses and corrosive influences cause damage more rapidly than either acting alone. WHB(4)

Corrosion of Aluminum Alloys. (**Studio sul problema della corrosione delle leghe di alluminio.**) J. DORNAUF. *Metalli Leggeri*, Vol. 1, May-June 1931, pages 41–44.

General comments with photographs of applications of Silumin to uses involving corrosion resistance. HWG(4)

Corrosion-Resisting Cast Iron. (**Korrosions beständiges Gusseisen.**) W. ACKERMAN. *Die Giesserei mit Giesserei-Zeitung*, Vol. 27, May 15, 1930, pages 263–266.

Since corrosion is an electrochemical process, the homogeneous structure of solid solutions is most favorable to resistance. Graphite accelerates corrosion. Si causes the precipitation of graphite but a cast iron with 0.84% Si corrodes more rapidly than one with 2.25% Si. The resistance of the higher Si casting is attributed not to the graphite but to the Si which is in the solid solution. P up to 0.5% increases the resistance, but more than 0.07% S is detrimental. From 14 to 22% Si creates an acid-resisting material which is not recommended for alkaline solutions. Ni, Cu and Cr reduce the rate of corrosion under certain conditions. The addition of Monel metal to cast iron produces an austenitic structure and increases the resistance to corrosion. Ha(4)

Some Factors Affecting the Corrosion of Buried Steel. F. L. BASSETT. *Journal Society Chemical Industry*, Vol. 50, May 8, 1931, pages 161–166T.

The author was consulted on the possible corrosion of a pipe line several hundred miles in length through the Iraq-Syrian desert. 80 samples of soil consisting of calcareous loams and clays, often sandy, gypsiferous or slightly salted were used in a preliminary survey. No acid soils were found in the series. Localized areas of acid soil, impregnated with free sulphuric acid, occur in the oil territory and springs of approximately 0.1 N sulphuric acid have been found. S and hydrogen sulphide are associated with the oil and bitumen seepages. Salt pans and salty ground are found in many of the shallow valleys and depressions of the desert. The conditions to be met were annual rainfall of about 8 ins. concentrated between November and March; a daily fluctuation of shade temperature of about 60° F.; and a seasonal fluctuation of more than 100° F. A 10 mile main of "rustless" iron had corroded badly, perforating in some places in 18 mos.; and ordinary steel mains had given similar but less severe trouble. Laboratory tests were organized as follows: 600 strips of steel 6 in. × 1 in. × 1 mm. were cut from pipes, one of British and the other of French manufacture, and finished to a uniform medium fine polish with No. 2 emery. The analyses of the steel were: "L," Mn 0.30–0.60%, P under 0.11%, S under 0.065%, C not given; "S", Mn 0.30–0.60%, P under 0.04%, S under 0.06%, C not given. The polished strips were half immersed vertically in the sifted (10 mesh) and well mixed soil previously wetted with 25% of water. Tests were run for 1, 2 and 3 mos. Specimens were cleaned by wire brushing. Partial analysis of 12 representative specimens of soil gave a range of composition of SiO_2 13.5–39.5%, Al_2O_3 4.2–14.2%, CaO 11.2–33.2%, MgO 2.6–9.0%, SO_3 0.5-7.0%. pH values on 80 samples gave a mean value of 8.0–8.2 with extremes of 7.5 in 2 cases and 8.5 in 2 others. Sand content ranged up to 24% in a few cases for "coarse sand" (0.2–1.0 mm.) and up to 36% for "fine sand" or "silt" (0.2–0.01 mm.). Detailed analyses are not given. The soils were classified according to chloride content and the results as summarized by the abstractor follow:

	One mo.'s exposure			Two mo.'s exposure			Three mo.'s exposure		
	% water retained at end	Corrosion loss of steels in g./dcm.^{2} "L"	"S"	% water retained at end	Corrosion loss of steels in g./dcm.^{2} "L"	"S"	% water retained at end	Corrosion loss of steels in g./dcm.^{2} "L"	"S"
Average of 10 soils with NaCl over 1%	18.23	0.303	0.251	17.52	0.570	0.529	12.14	0.807	0.769
Average of 7 soils NaCl 0.2–1%	16.53	0.403	0.373	16.34	0.644	0.593	9.03	1.089	0.931
Average of 16 soils with NaCl 0.005–0.2%	14.3	0.594	0.546	13.57	1.182	1.169	5.14	2.04	1.82
Average of 47 soils with NaCl "nil"	14.6	0.443	0.445	14.4	0.923	0.895	4.64	1.544	1.343
Synthetic soil consisting of fine sand initially saturated with 0.1 *N* NaCl		0.40	0.56	13.3	1.81	1.74	5.7	2.74	2.64

In all cases, the corrosion took the form of localized pitting. The most corrosive soils, apart from the highly salted specimens, were those of close and dense texture. The soils which had the greatest water retentivity showed, as a rule, the least corrosion of the steel. A chloride content from 0.2% upward corresponded with both an increase of water retentivity and a marked average decrease of corrosion. Maximum corrosive attack occurs in the group of slightly salted soils below 0.2%. Further tests, using nonsalty soils with the addition of sodium and calcium chlorides, are under way. VVK(4)

Thin Films in Relation to Corrosion Problems. U. R. EVANS (Cambridge University). *Institute of Metals, Advance Copy* No. 586, Sept. 1931, 17 pages.

The tenth Autumn lecture to the Institute of Metals, delivered Sept. 13, 1931 in Zürich. Discusses the influence of films on the corrosion of both ferrous and non-ferrous products. In both groups thin, invisible oxide layers have a predominant influence on corrosion. JLG(4)

The Corrosion of Metals. Part I. General Theory. WILH. PALMAER. Svenska Bokhandelscentralen A. B., Stockholm, 1929. Paper $6^{1}/_{2} \times 9^{1}/_{4}$ inches, 347 pages. Price 20 kronen.

The Corrosion of Metals by W. Palmaer is in three parts, of which Part I discusses the general theory, Part II will deal with special researches concerning the dissolving of metals and Part III will deal with the special theory of the corrosion of iron. Part II and Part III will be published shortly. The present 347 pages are confined to an exposition of the dissolving of metals in acids from the standpoint of the "theory of local galvanic elements" compared with the mass action and the diffusion theories. The primary factor when metals are dissolved in acids is the activity of local galvanic elements. The intensity of the local currents is affected by the same factors as have an influence upon the currents delivered by galvanic elements. Among these are diffusion and convection, which affect the concentration of the ions in the layer next to the cathodes and consequently the E. M. F., while the cases where the current intensity depends only upon diffusion and convection are rare. Since the formation of insoluble substances such as rust appearing in the corrosion proper at ordinary temperature, is in all probability preceded by a dissolving of the metal in question, one must suppose that the primary thing in corrosion also is the activity of local galvanic elements. This particular point will be taken up in Part III. From the viewpoint of "local galvanic elements," therefore, the velocity of dissolution of metals would be determined by the difference in the electromotive force with which the metal tends to enter into solution as ion and the electromotive counter-force which arises from the hydrogen deposited on the metal, by the specific electrical conductivity of the solution and by the resistance capacity of the local galvanic elements. The general quantitative expression for all cases of the dissolving or corrosion of metals is given as $\rho = f \cdot i$ or $\rho = f \cdot e \cdot \frac{x}{C}$ where ρ is the reaction velocity, f is a proportionality factor, the value of which is determined by the measure adopted for the reaction velocity, i the total intensity of the local currents, e the electromotive force of the local elements, x the specific electrical conductivity of the solution and C the resistance capacity of the local elements. Some very comprehensive data on the solution of aluminum and of a gray pig iron in hydrochloric acid are given and discussed. The argument of the author for the existence of local galvanic elements is well substantiated. However after 347 pages of data and discussion a few pages devoted to a concise clear statement of exactly the facts produced and a brief interpretation of them would be welcomed. Otherwise the reader is liable to feel somewhat muddled unless he very laboriously digs out the information he wants. Since, however, some very important points are to be discussed in the following Part II and Part III perhaps we can expect some such summary when the other parts are finished. The translation is adequate but could be considerably improved by better sentence construction and a more careful choice of words. —V. V. Kendall (4)-**B**-

Seasonal Variation in Rate of Impingement Corrosion. ALAN MORRIS. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 431, Sept. 1931, 9 pages.

Tests extending over about 2 years have shown that the rate of impingement corrosion varies with the seasons; the attack is most rapid during the summer months. The water used was taken from the Penguonnock river at Bridgeport, Conn. The test method used was similar to that described by Bengough, May and Pirret. The corrosion of Admiralty metal was greater than that for nickel silver, the expected rates being 1.2 and 0.9 mils/100 hr., respectively. Contains 4 references. JLG(4)

Effect of Physical State of Small Amounts of Copper upon the Rate of Corrosion of Lead by Sulfuric Acid. E. G. MAHIN & E. J. WILHELM. *Industrial & Engineering Chemistry*, Vol. 22, Dec. 1930, pages 1397–1404.

It is shown that rapidly cooled lead is improved in its resistance to attack by sulphuric acid, by addition of copper up to 1%, but that, if its practical application involves continued heating, even at a temperature of 100° C., the copper falls out of solid solution and it then may accelerate the acid attack. Under such heating conditions, copper up to 0.20% improves the qualities of lead, but beyond this limit it promotes destruction of the sheet by the acid. 24 references. This paper was presented before the Division of Industrial and Engineering Chemistry of the American Chemical Society at the Sept. meeting, 1930. MEH(4)

The Corrosion of Cans. T. H. MORRIS & J. M. BRYAN. *Food Manufacture*, London, Vol. 6, No. 4, 1931, pages 100–102.

Fe, Sn, Sn-Fe couples and Sn plate were immersed in 0.5% citric acid containing Na citrate to regulate the pH in the presence and absence of air. O_2 increased corrosion of Fe at low acidities more than at high acidities. Sn was not attacked by non-oxidizing organic acids but was quite readily attacked when O_2 was present. Sn-Fe couples and Sn plate were quite similar in behavior in that (1) Sn salts in the solution reduced the corrosion of Fe; (2) Sn was attacked slowly even in the absence of air and especially at pH's from 4 to 5.5; (3) H_2 was evolved from the iron surface and this was attributed to the high over-potential of H_2 on Sn; (4) there is a reversal of potential, Fe is anodic at first; (5) if Sn corroded rapidly, Fe corroded slowly and vice versa. Substances present in unrefined beet sugar, beet sugar and agar-agar, and inverted cane sugar were found to have inhibitive properties, the first on corrosion of Fe; the second on Fe and Sn and the third on Sn. SO_2 accelerated the corrosion of Fe at a pH of 2.4 and retarded it at 5.5. SO_2 makes the Fe permanently anodic to Sn since a film of Sn sulphide forms on the Sn. WHB(4)

The Effect of Artificial Ageing upon the Resistance of Super-Duralumin to Corrosion by Sea-Water. K. L. MEISSNER. *Journal Institute of Metals*, Vol. 45, no. 1, 1931, pages 187–208; abstracted in *Engineer*, Vol. 151, Apr. 3, 1931, pages 373–374.

Includes discussion. See *Metals & Alloys*, Vol. 2, July 1931, page 128. LFM(4)

On the Chemical Reaction between Metallic Magnesium and Aqueous Chloride Solutions. JITAKA. *Proceedings Imperial Academy*, Tokio, Vol. 6, No. 9, 1930, pages 363–366.

The particular behavior of Mg in Cl solutions in which, contrary to its behavior in other solutions, Mg is quickly destroyed was thoroughly investigated and the dependency from the H ion concentration determined. The following ranges of reaction are stated for Mg: (1) If H' is less than 10^{-4}, a vivid dissolution of the metal takes place. The velocity of reaction increases with the reduction of H ions. (2) In the range from $H' = 10^{-4}$ to 10^{-11}, the velocity of reaction remains constant; it is now independent of the concentration of H ions. The dissolution forms films which, in time, act as protection. Stirring reduces the reaction velocity. (3) From $H' = 10^{-11}$ to 10^{-14}, the reaction velocity decreases, due to greater viscosity of the solution. In solutions above 10^{-3}, the Cl ions are able to break the protective film but due to the low concentration of H ions, the reaction is not accelerated thereby. Ha(4)

Pure Iron and Its Application in the Gas Industry. M. A. REYNAUD. *Gas Journal*, Vol. 194, June 10, 1931, pages 831–832.

Review of paper presented before the Annual Congress of the Association Technique de l'Industrie du Gaz en France, April 21 to 25, 1931. The causes responsible for the corrosion of iron and steel are discussed and referred to the fact that present-day steel is much more readily corroded than puddled iron, which had its immunity due to its chemical homogeneity and to low content of Mn and S. The homogeneity of chemical composition and physical condition and of uniformity of aeration was emphasized. MAB(4)

Increasing business throughout the middle western section has necessitated the recent opening of a factory branch office in Chicago by the **Alloy Metal Wire Co.**, Moore, Pa. The new office at 504 Produce Exchange Bldg., 14th and Racine Sts., has been placed in charge of Mr. R. L. Howe, formerly with the Truscon Steel Company.

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The **Midland Steel Products Co.** is installing additional equipment at its Cleveland plant for the production of its new axle housing, the result of orders recently received from the makers of a new light car. Midland frames will also be used on this car. The company's newly developed axle housing is now being used by some of the largest producers of automobiles and over $100,000 of equipment has been installed in recent months for its manufacture.

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Lancaster, Allwine & Rommel announce the removal on December 1, 1931, of their patent law offices to 815 Fifteenth Street, N. W., Washington, D. C.

The Corrosion of Power Plant Equipment by Flue Gases. Henry Fraser Johnstone. *University of Illinois Engineering Experiment Station Bulletin* No. 228, June 1931, 120 pages.
The work carried out in the investigation was done in coöperation with 7 power companies in and about Chicago. The investigation so far has been of a technical nature and no attempt has been made to try out new features of operation under plant conditions. It has been the general object first to find out what the factors are that are contributing most to corrosion, and then to study methods of their elimination or the prevention by some other means. The conditions which are prevalent in flue gases that cause corrosion and some of the steps that may be taken toward their elimination are described. The reactions that take place in a boiler furnace are discussed and their effect on corrosion and slag formation are brought out. A description of the experimental work carried on in the laboratory on corrosion and its results are also presented. These substantiate the ideas of the cause of the corrosion suggested by the plant data. The results of tests on various corrosion-resistant alloys and protective coatings under the conditions existing in the flue gases are reported. A description is also given of new methods for the determination of the dew-point and sulphur dioxide and trioxide concentrations in flue gases. Finally, a discussion of the fundamental corrosion reactions is made in order that the work reported may be carried forward by others who may be interested in this field. Many tables and illustrations of typical examples of corrosion are presented. WAT(4)

The Corrosion of Metals. H. Sutton. *Aircraft Engineering,* Vol. 2, Aug. 1930, pages 209–210.
Intercrystalline corrosion of duralumin is reduced to a minimum when the alloy is heat treated at a high temperature, quenched in cold water and allowed to age at normal temperature. Although rapid aging at elevated temperatures is sometimes used for producing high strength Al alloys, such practice has a harmful effect on corrosion resistance. Cold working increases slightly the corrosion tendency. The anodic oxidation process, in which an adherent film of oxide is produced by electrolytic oxidation of Al alloys in chromic acid solution, is valuable for protection of aircraft parts and also to show imperfections in the metal. Mg alloys, Cr-Ni steels and ordinary steels protected by oils, enamels, ZnO and Al paints are also used in the aircraft industry. (4)

Rust Prevention during Shutdowns. Bernard Jeffs. *Iron & Steel o Canada,* Vol. 14, Mar. 1931, page 51.
An excerpt from Houghton's "Black and White," in which special attention is directed to the fact that lubricating oils, petrolatum and similar compounds lack the necessary properties for preventing rusting of machinery. Methods which may be adopted to bring about the necessary effects are described. See *Metals & Alloys,* Oct. 1931, page 207. OWE(4)

The Use of Aluminum for Oil Lease Tanks. Part II. Laboratory Tests. Ludwig Schmidt, John M. Devine & C. J. Wilhelm. *United States Bureau of Mines, Report of Investigations* No. 3131, Oct. 1931, 16 pages.
Low-temperature salt-water corrosion of Al tank sheets in contact with natural brine was primarily caused by the $MgCl_2$ and $CaCl_2$ in the brine. FeS or O greatly accelerated the corrosion. High-temperature corrosion (Al steam coils) was caused primarily by the precipitation of bubbles of H_2S or CO_2 on the surface of the metal. Bimetallic corrosion, which was encountered where Al-steel contacts existed in the presence of brine, is explained by the relatively anodic character of Al as compared to steel. Different grades of commercial Al vary in their resistance to the types of corrosion studied. AHE(4)

The Corrosion of Metals. Alfred Stansfield. *Engineering Journal,* Vol. 14, Aug. 1931, pages 444–446.
Freedom from corrosion may be approximated by having the metals pure or by having the constituents of the metal homogeneous. Electrolytic Fe is not readily attacked, being perfectly pure and homogeneous. Some electrolysis will take place, however, due to the fact that the orientation of the atoms in the different grains will be in different directions. Even if the metal is homogeneous, corrosion can occur through differing compositions at different parts or by difference in O concentration. Examples and photomicrographs are given. VVK(4)

Effect of Steaming on the Life of the Extractors of Glover-West Retorts. M. H. Seramme. *Gas Journal,* Vol. 194, June 10, 1931, page 832.
Reviews paper presented before the Annual Congress of the Association Technique de l'Industrie du Gaz en France, April 21 to 25, 1931. Fracture occurs first in the hottest retorts and may become apparent after a life of 44 to 52 mos. It is due to growth of the cast iron leading to development of porosity and resulting oxidation, as a result of high temperature. The use of a special alloy, e. g., one of Bi-Cu-Cr is suggested. MAB(4)

The Protection of Magnesium Alloys against Corrosion. H. Sutton & L. F. LeBrocq (Royal Aircraft Establishment). *Institute of Metals, Advance Copy* No. 583, Sept. 1931, 20 pages.
The addition of 1.85% Mn to Mg slightly increased its resistance to the sea water corrosion test, but not sufficient to warrant the use of this alloy. Other methods of increasing the corrosion resistance of Mg, including sherardizing, calorizing, metal spraying, anodic treatment, cathodic treatment and chemical treatment were studied. The best resistance was obtained by chemical treatment. Actual tests proved that after a treatment with a chromate bath the metal was resistant to all but the most corrosive marine conditions. A lanolin coating after this treatment is recommended. Prior to this treatment parts can be cleaned by a 10% nitric acid treatment if fine tolerances are not demanded, but where little material can be removed, cleaning can be done with a 2% caustic soda solution. Sand blasting is not recommended. Additional protection can be obtained by coating the surface after chromate treatment with a cellulose enamel. Contains 4 references. JLG(4)

Investigation of Materials to Reduce Steam Turbine Blade Wear. J. L. Ray. *Power,* Vol. 73, May 26, 1931, page 804.
A general discussion of erosion of turbine blades by steam is presented. Steam turbine blading has been and continues to be one of the main sources of operating trouble. Although wear has never been excessive, it has necessitated enough blade replacement to justify the researches made to reduce or eliminate it. Laboratory tests are not satisfactory; the material must be subjected to actual service tests. The following materials are discussed in a general way although the results of no actual tests are given: stainless iron, 5% Ni steel, an alloy of 36% Ni and 12% Cr, pure W, pure Ta, stellite, an alloy of 60% Ni and 15% Cr, an 18% Cr-8% Ni steel and Nitralloy. A number of photographs are presented which show the type of erosion produced by steam on a number of the alloys mentioned above. WAT(4)

Exterior Protection of Metal Tubes against Corrosion. (La protection extérieure des tuyaux métalliques contre la corrosion.) A. Rocca. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 419–428; *Metallbörse,* Vol. 20, Aug. 16, 1930, page 1829.
Deals with bituminous and cement coatings, especially with a particular coating sold under the trade name, "Dalmine." See also *Metals & Alloys,* Vol. 2, Jan. 1931, page 2. HWG(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Alloys of Iron Research. Part X. The Chromium-Iron Constitutional Diagram. FRANK ADCOCK (National Physical Laboratory.) *Iron & Steel Institute, Advance Copy* No. 2, Sept. 1931, 48 pages.

Bibliography of 34 references. Previous work on the Fe–Cr system is reviewed. Alloys were prepared from metals of high purity, and the entire series of alloys was carefully studied. The materials were melted in thoria-lined alumina crucibles in vacuo. Freezing point temperatures were obtained by thermocouples for the Fe-rich alloys, and by an optical pyrometer for the Cr-rich alloys. Thermal, dilatometric, microscopic and magnetic methods were used in determining the transformations in the solid. The melting point of Cr was found to be 1830° C. Fe-Cr alloys form a continuous series of solid solutions, with a minimum melting point of about 1500° C. at 20% Cr. (Unless otherwise stated all compositions are in atomic percentages.) The γ loop extends to 11.6 wt. % Cr. As Cr is added to Fe, the A_3 temperature is lowered to a minimum at about 8% Cr, after which it rises to meet the lowered A_4 transformation. The magnetic transformation temperature is lowered with increasing Cr until at about 70% Cr it occurs in the neighborhood of atmospheric temperatures. In alloys containing about 40–70% Cr the magnetic transformation is dependent on the previous thermal history of the alloys. The Brinell hardness-composition curve of the annealed alloys has a maximum hardness value of 345 at 75 % Cr. The electric resistance-composition curve is of the inverted U type characteristic of a continuous series of solid solutions. Density-composition and lattice parameter-composition curves are also given. They are not straight lines. Values of magnetic induction for several magnetizing forces are given for the alloys containing less than 70% Cr. JLG(5a)

The Equilibrium of Certain Non-Metallic Systems. Part I.—The Equilibrium of the System FeO–MnO. Part II.—The Equilibrium of the Systems MnS–MnO, MnS–$MnSiO_3$ and $MnSiO_4$. J. H. ANDREW, W. R. MADDOCKS &. E. A. FOWLER. (Technical College, Glasgow.) *Iron & Steel Institute Advance Copy* No. 1, Sept. 1931, 26 pages.

Pure FeO was prepared by heating ferrous oxalate in vacuo at 700° C. This material analyzed at least 99.5% FeO, and its melting point was found to be 1410° C. MnO was prepared by heating manganese oxalate at 850° C. in vacuo. Its melting point was 1585° C. Equilibrium in the FeO–MnO system, and other systems, was studied thermally and by means of microscopic examination. FeO and MnO form a continuous series of solid solutions. MnS, 99.8% pure, was obtained by passing H_2S over chemically prepared MnS at a temperature of 850° C. In the MnO–MnS system a eutectic is formed at about 50% MnO and 1280° C. $MnSiO_3$ was prepared by fusing pure MnO with sand. In the $MnSiO_3$–MnS system a eutectic is formed at about 10% MnS and 1250° C. About 1.5% MnS is soluble in the solid silicate and about 1.3% of the silicate is soluble in MnS. Fe_2SiO_4 was prepared by fusing pure FeO with sand. In the Fe_2SiO_4–MnS system a eutectic occurs at 10% MnS and 1060° C. A small solid solubility (1 or 2%) is found at both ends of the diagram. The sulphide-silicate inclusions found in steel probably melt below the forging temperature, but the fact that they ball up rather than surround the grains explains why they do not render ordinary steel unforgeable. As an appreciable amount of MnS is soluble in oxide inclusions the spots shown on sulphur prints are probably indicative of oxide inclusions, and are not caused by purely sulphide particles. 7 references. JLG(5a)

Identification of Inclusions in Steels. LELAND E. GRANT. *American Society for Steel Treating, Preprint* No. 29, 1931, 14 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. 7 references are cited. 21 micrographs illustrate the heterogeneity of inclusions in steels. The examination of inclusions with the usual identifying etching reagents is not entirely adequate to the study of the various phases present in non-homogeneous inclusions. The development of more selective reagents is required for this study. WLC(5a)

Effect of Heat Treatment upon Ferrite Banding in Steel. WILBER E. HARVEY & BRADLEY STOUGHTON (Lehigh University). *American Society for Steel Treating, Preprint* No. 30, 1931, 8 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The authors show in 15 micrographs the results of their study of heat treatments for the elimination or reduction of ferrite banding. Long heating above the Ac_3 point followed by water quench and subsequent drawing or cooling in air after such heating entirely eliminates this structure. Cooling in the furnace greatly improves the structure. WLC(5a)

Submicroscopic Inclusions in Steel. C. H. HERTY, JR. (Pittsburgh Station, U. S. Bureau of Mines). *Metal Progress*, Vol. 20, Oct. 1931, pages 37–42.

Extracts from the Sixth Campbell Memorial Lecture delivered before the American Society for Steel Treating in its Boston Convention, Sept. 1931. The author divides non-metallic matter into particles visible at 250 ×, smaller inclusions, and solid solution material. Evidence of a slight solubility of liquid steel for SiO_2 is presented. The association of ferrite banding with stringers of certain types of inclusions and absence of such association with other types of inclusions is shown. Macrophotographs are given illustrating these points. The relation of internal seams to the method of deoxidation of the steel is discussed. WLC(5a)

The Structures of the High-Chromium Stainless Steels and Irons. EDGAR C. BAIN. *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1419–1426.

The paper gives a compilation and interpretation of some of the structures found in high Cr non-corroding alloys. The properties are very closely dependent on the structure of the metal; therefore, its observation affords a convenient method of recognition and control of the properties to be developed industrially. For each purpose, an alloy of definite properties will be best suited. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 34. Ha(5a)

Investigations into the Influence of the Composition of the Slag on the Structure of Gray Iron Alloys. (Untersuchungen über den Einfluss der Schlackenzusammensetzung auf das Gefüge grauer Eisenlegierungen.) E. DIEPSCHLAG & L. TREUHEIT. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Sept. 4, 1931, pages 705–710.

On the basis of melting experiments in lined graphite crucibles, an influence of silico-alumina slags and alumina-lime slags against silicic acid-lime slags is determined. Under slags with much lime and alumina, iron has the greatest tendency to solidify in the unstable system with fine-eutectic arrangement of the graphite in the remaining melt. The silicic acid-lime slag does not change the formation of graphite because it is kept from the original iron. It can be concluded for practical purposes that it becomes feasible to obtain a desired structure by melting under a certain slag. The possible explanation of the cause of the differences is suggested and the various influences of the addition of Al and Zn are illustrated by means of tables and micrographs. Ha(5a)

Structure of a Used Shear Blade. (Gefüges eines gebrauchten Blockschermessen.) F. FETTWEIS. *Stahl und Eisen*, Vol. 51, Apr. 23, 1931, pages 528–529.

The examination of the shear blade shows the ferrite in a peculiar pine-tree arrangement. GN(5a)

Structure & X-Ray Analysis (5b)

Emission of Electrons from Metals. KARL T. COMPTON. *Journal of the Western Society of Engineers*, Vol. 36, June 1931, pages 137–148.

Actually there are five ways known whereby electrons can be caused to escape from metals. One of these is by raising the metal to a high temperature. This is usually known as thermionic emission. The second is by illuminating the metal by some suitable form of radiation, such as light or X-rays, which is known as the photo-electric effect. The third is by bombarding the metal with something moving with sufficiently high speed. The only things which can move with sufficiently high speed are electrons or ionized atoms or molecules, because they are electrically charged and can be given a high speed by passing them through a high voltage. The fourth method is by the contact of some one of these excited atoms or molecules with the metal; that is, a molecule which has inside of it an abnormally large amount of energy, only temporarily, to be sure. If, while in that state, it comes in contact with the metal, that energy may be delivered to the metal and result in the expulsion of one or more electrons. And the fifth way by pulling the electrons out of the metal by sufficient force. The only force that can pull an electron out of the metal is an electric force. That means applying a high voltage to the metal, sufficiently high so that the electrons are pulled out. The author discusses each method in some detail. WAT(5b)

An X-Ray Study of the Alloys of Silver with Bismuth, Antimony and Arsenic. Part I. S. J. BRODERICK & W. F. EHRET. *Journal of Physical Chemistry*, Vol. 35, Sept. 1931, pages 2627–2636.

An article accompanied by 3 diagrams and 2 sets of powder photograms, one of the system Ag–Bi and the other of the system Ag–b. Experimental methods are discussed and the conclusion is reached that the equilibrium diagrams which have been published for these systems by G. I. Petrenko are supported by the author's work. The maximum solubility of Bi in Ag is stated to be about 5.5%; that of Sb in Ag, 6%. OWE(5b)

X-Ray Analysis in Foundry Practice. (Roentgentechnik in der Giesserei.) R. BERTHOLD. *Die Giesserei mit Giesserei-Zeitung*, Vol. 26, Nov. 15, 1929, pages 632–634; Dec. 1, 1929, pages 666–672.

The use and advantages of X-ray inspection of castings and its value, economically, are explained. Beside the usual cast iron or cast steel, the light metals are also treated. Ha(5b)

The Reasons Responsible for the Widening of X-Ray Lines Obtained by the Debeye-Scherrer-Hull Method and by the Bragg Method. (Die Ursache der Lienienverbreiterung bei Pulver- und Drehkristallaufnahmen mit Röntgenstrahlen.) U. DEHLINGER. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 147–149.

The author describes the broadening lines of X-ray photograms to the following 3 sources: (a) small deviations in the space lattice constants due to concentration differences in solid solutions on the one hand and elastic distortions on the other hand; (b) abnormal small grain size as encountered in metals deposited by sublimation or electrolysis in metals colloidally dispersed and probably in some eutectoids, as, for instance, in pearlite and in martensite; (c) "quick fluctuations" in the lattice, that is to say, by inhomogeneous lattice distortions caused by the inhomogeneous distribution of a mixed crystal's component or as a result of elastic internal stresses. In conclusion, the author critically discusses the influence of rolling upon the broadening of X-ray spectrogram lines which phenomenon he ascribes to an inhomogeneous distortion or "bending" of the individual crystals created during the process of rolling. EF(5b)

On the Molecular Sphere of Activity of Metals and Some Conclusions Concerning Cohesive Forces. C. BENEDICKS. *Reprint, Arkiv for Mathematik, Astronomi och Fysik*, Vol. 22 A, No. 24, 1931, 13 pages. (In English.)

Methods of mathematical physics are applied to the problem of cohesive forces between molecules of metals. The radius of the molecular sphere of activity is taken as equal to twice the surface tension divided by the internal pressure. Calculating this for 13 metals, the order of magnitude of the radius agrees fairly well with the apparent atomic radius deduced from X-ray evidence. Poor agreement in some cases is ascribed to the use of surface tension data for the liquid state, while the data for internal pressure are for the solid state. The radius of molecular activity and the apparent atomic radius are both periodic functions of the atomic number. Bodies like Na with large atomic distances are soft, while those with small atomic distances are hard and brittle. If the atomic distance decreases successively, as on cooling of a metal, there will come a position beyond which further decrease of atomic distance will result in no increase in hardness. With thermal agitation nearly vanishing, the atoms may agglomerate into larger units. This may account for super-conductivity. HWG(5b)

Inspection of Welds with Gamma Rays. GILBERT E. DOAN (Lehigh University). *American Society for Steel Treating, Preprint* No. 34, 1931, 8 pages.

Paper to be read and discussed before the Boston Convention of the Society in Sept. 1931. The author reports results of examination of welds by the use of γ radiation. WLC(5b)

Electron Diffraction from Oxygen-Covered Tungsten. (Ueber Elektronenbeugung an sauerstoffbedecktem Wolfram.) W. BOAS & E. RUPP. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 18, 1931, pages 45–51; *Annalen der Physik*, Vol. 5, No. 7, 1930, page 983.

Tungsten was heated to 1800°, 2500° and 3000° C. in vacuum and the electron diffraction maxima determined for various angles of incidence and at various temperatures. Then it was treated with O at 400° C., the maxima determined and the oxygen-coated material then heated to various higher temperatures and the maxima determined at these temperatures. The results indicate that the surface layer on the oxygen-treated tungsten conforms to Langmuir's criteria for a monatomic layer of oxygen. In this case, and in the case of the surface of passive Fe, an O layer appears to be present, the same mode of combination of gas and metal atoms occurring in both cases. The experiments alone do not allow an explanation on the basis of simple saturation of the valence of the metal atoms by the gas atoms. The observed lattice spacing might be due to several layers of gas atoms or to a regular solution of oxygen in tungsten. HWG(5b)

X-Rays Suitable for the Determination of Small Changes in the Lattice Constant of Alpha Iron. (Eine zur Bestimmung von kleinen Aenderungen in der Gitterkonstante des α-Eisens geeignete Röntgenstrahlung.) A. E. VAN ARKEL & W. G. BURGERS. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 149–151.

The $K\alpha$ lines from Co are especially suited for the production of high quality diffraction photograms of Fe at ordinary temperatures from which the lattice constant, a_0, can be determined with great accuracy. If the adsorption limit of the radiated metal lies between the wavelengths of the $K\alpha$ and $K\beta$ lines of the anode, the β line will be selectively absorbed and will not appear, confusing the photogram. The application of this principle, using a camera with a high grazing angle, permits the determination of very small changes in the lattice constant of α Fe. Representative values of a_0, corrected to $\theta = 90°$, from different types of iron are given; Fe prepared from oxide by reduction with H, $a_0 = 2.8614$; electrolytic Fe, $a_0 = 2.8614$; first steel, $a_0 = 2.8623$; second steel, $a_0 = 2.8686$; roller-bearing steel with 1% Cr, $a_0 = 2.8635$; die steel with 12% Cr, $a_0 = 2.8666$; chromium iron with 25% Cr, $a_0 = 2.8675$. No change could be detected with adsorbed H, which must therefore be less than 0.02%. This method may also be used to determine internal stresses by the method of Sachs and Weerts (*Zeitschrift für Physik*, Vol. 60, 1930, page 481). RFM(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Watching Stresses at Work. HENDLEY N. BLACKMON. *Machinery*, June 1931, page 737.

The author discusses the use of the "photo-elastic" apparatus, which shows, by different colors on a screen, the magnitude and location of stresses in models of the parts being investigated. The models are made from transparent materials. Loads are applied to the models in the same manner as in actual service. Since stress distribution does not depend upon the material, as long as the elastic limit is not exceeded, results obtained with the models apply directly to steel and other materials. This photo-elastic apparatus thus provides a practical method of studying stresses in both simple and complicated parts, either stationary or moving, and it is hoped will solve the difficulty in determining the strength of machine members or other structures that are of such design that a satisfactory calculation cannot be made by the use of mathematical formulas. (6)

Anisotropy in Magnetic Materials. (Anisotropie in magnetischen Werkstoffen.) O. DAHL & J. PFAFFENBERGER. *Zeitschrift für Physik*, Vol. 71, No. 1–2, 1931, pages 93–105.

Based on the observation that the regularly crystallizing metals and alloys are isotropic for the physical properties, a method was developed to determine deformation and recrystallization textures by the magnetic anisotropy of regularly crystallizing metals. The tests were made on strips of Fe, Ni and an Fe-Ni alloy. The possibilities of this method for a practical determination of stresses are discussed. Ha(6)

The Stresses in Rotating Discs. A. F. CORNOCK. *World Power*, Vol. 16, Aug. 1931, pages 94–98.

The ordinary theory of stresses in rotating discs involves certain arbitrary assumptions as to the stress-strain relationships. A new theory is here developed, based directly on the theory of elasticity without recourse to these arbitrary assumptions, and the theory is worked out for hyperbolic and conical discs. It appears that the hoop tensions in hyperbolic discs, as calculated on the new theory, are generally larger than the hoop tensions calculated on the old theory, while the radial tensions are smaller. The method employed should be applicable to a wider range of problems. The article is almost entirely mathematical. WAT(6)

Deformation of Metals, with Special Reference to the Tensile Test. C. H. DESCH. *Transactions Institution of Engineers and Shipbuilders in Scotland*, Vol. 72, *Yearbook* 1929, pages 348–385.

The tensile test is a working test of the quality of metals but does not give the true elastic limit. The author prefers the proof load. Severely deformed metal has a lower density than the unstrained. Reduction of area at the point of failure is more closely related to the working properties of metals than is elongation. Viscous flow is a function of temperature and increases with time under constant load. The capacity of metals to be hardened by cold work can be inferred from the slope of the respective curves where the reduction of area of the cross section forms the abscissa and load in thousand pounds the ordinate. WHB(6)

Development of Casings for Deep Wells. F. W. BREMMER. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 355; abstracted in *Heat Treating & Forging*, Vol. 16, Oct. 1930, pages 1292–1294.

Paper presented at the Sept. 1930 meeting American Institute Mining Engineers, in Chicago. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 908. Ha(6)

Actual Relation between Sheet Metal Thickness and Erichsen Impression. KARL DAEVES. *Metal Stampings*, Vol. 4, Apr. 1931, pages 306, 312.

Abstract of an article translated from *Stahl und Eisen*. See *Metals & Alloys*, Vol. 2, Mar. 1931, page 66. JN(6)

Mechanical Testing. Vol. I. Testing of Materials of Construction. R. G. BATSON & J. H. HYDE. E. P. Dutton, New York, 1931. Cloth, 6 × 8½ inches, 465 pages. Price $6.50.

This is a second and enlarged edition of the well-known work by 2 members of the Engineering Department of the National Physical Laboratory, England.

It is evidently written with the main idea of describing the apparatus used in testing materials for conformity to specifications. The catalog method of description is used, particular makes of testing machines being described and the parts being pointed out in such fashion as this. "The movement of the lever (C) is produced by a connecting rod (D) actuated by a variable eccentric (E) which is on the main shaft driven by the motor (F)." The authors even give the street and number of a firm from which a silica tube was obtained, on which a heating coil for a set-up for high temperature testing used by the authors was wound. This sort of thing keeps the authors from seeing the woods for the trees. While one may get from the context and by indirection, ideas as to the importance of axial loading in a tensile test, and side comments are made on it and many self-aligning grips are pictured, yet the authors do not bear down on its importance as much as it deserves.

The preface to the second edition states that rapid advances have been made since the publication of the first edition, in fatigue testing, hardness testing, and the testing of materials at high temperatures. These sections having been specially rewritten, one would expect a clear appraisal of the applicability of the test methods described. Calorimetric methods for rapid determination of endurance limit are described and the statement made that results are in good agreement with those found by other methods, although this is by no means a general truth and the authors probably know it. Certainly some of their N. P. L. colleagues know it. The authors do, however, recognize that in high temperature creep testing, it is doubtful whether short time flow tests can give accurate results. Such comments are, however, relatively rare, the authors being content to list a lot of mechanical devices with little attention to their relative accuracy and utility. Some critical appraisal of equipment and methods is, of course, included and a small amount of metallurgical data comes in to illustrate a point, but those features are subordinate to a description of the tools used. In the description of wear testing equipment there is lacking any discussion of what the results mean when one gets them.

It is dangerous to use the catalog method, for it can never be complete and each reader will note omissions of devices he would consider important enough to mention in such a catalog. The reviewer would have expected descriptions of the Tuckerman optical strain gage, the Templin grips for tension testing and the R. R. Moore fatigue machine. Any reviewer in any other country will note omissions of apparatus he would expect to see.

The book has value, as it does include description of, and reference to publications on, many modern testing methods and devices not included in the first edition. However, it lacks the "fundamentalism" of most books by N. P. L. authors, not being in the same class with the books on Fatigue of Metals by Gough and Creep of Metals by Tapsell. It should have been entitled "Apparatus for Mechanical Testing" rather than "Mechanical Testing." The N. P. L. staff certainly could write a fine book on the principles and objects of mechanical testing, on the proper types of apparatus to use to get results of desired accuracy and on how to interpret the test results. Doubtless the present authors could do so, but they have not. It is to be hoped that a third edition will feature principles instead of just cataloging tools. HWG(6)

Modern Material Testing Machines. (**Moderne Materialprüfmaschinen.**) O. Böttger. *Metallwirtschaft*, Vol. 10, Sept. 11, 1931, pages 720–723.

Various types of testing machines are described. Tensile testing machines are driven mechanically through screws or hydraulically with pumps. To measure the load on the test piece, balancing scales or pressure gages are used. Universal testing machines are a combination of tensile compression and bending test machines. The principal construction features of various types are described, also torsion, impact, Brinell and Rockwell hardness machines, Erichsen tester for deep drawing sheet material and endurance testing machines producing alternating tensile, compression, bending or torsional stresses. CEM(6)

The Graphical Evaluation of the Bending Test. (**Die zeichnerische Auswertung des Biegeversuchs.**) R. Mitsche. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 20, 1931, pages 246–247.

A generally applicable method is developed to determine graphically the bending strength of cast iron. A numerical example illustrates the method. Ha(6)

Automotive Engine Piston Tests. (**Werkstoffprüfung für Kolben von Fahrzeugmotoren.**) Ernest Mahle. *Maschinenbau*, Vol. 10, May 21, 1931, pages 345–350.

A complete description of the methods and equipment used in the testing of pistons as to temperature, expansion, conductivity, hardness, strength in compression, change in shape, effect of piston pins, etc. WHB(6)

The Status of the Impact-Notch Test in Germany. (**Der Stand der Kerbschlagprobenfrage in Deutschland.**) M. Moser. *Krupp'sche Monatshefte*, Vol. 12, Aug.–Sept. 1931, pages 223–229.

The following questions are discussed: What advantages does the notch-impact test offer which other mechanical tests do not possess and what possibilities does it have from the point of view of measuring technique? Is this test more suitable for standardization than any other? From the results of tests to clarify the situation, a new arrangement of the specimen for the notch-impact test has been developed. This arrangement promises well for general acceptance because it gives reliable, reproducible results. Ha(6)

On the Yield-Point of Mild Steel. Fujio Nakanishi. *Report* No. 72, *Aeronautical Research Institute*, Tokyo Imperial University, June 1931, 140 pages.

Various theories concerning the elastic limit have been advanced, but none of them can account for the yielding of mild steel. The object of this paper is to propose a new theory. The author considers that the yielding of material is a problem of stability, analogous to the critical point of viscous flow through a pipe. The material will yield when the state of stress becomes unstable; all the stress distribution in the body must therefore have effect on the yield-point. (6)

The Work-Hardening Capacity and Elongation Properties of Copper. Hugh O'Neill & J. W. Cuthbertson. *Institute of Metals, Advance Copy* No. 580, Sept. 1931, 17 pages.

The various methods for determining work-hardening capacity are discussed. Cupping tests are frequently used with sheet materials, but other forms of tests are needed for testing material in other forms. Data obtained by several different kinds of tests on Cu are given. The Tetmajer "uniform elongation" and the Bertella-Oliver "extensibility" were found to be accurate measurements of the workability. Meyer "n" values were erratic. The Herbert pendulum results did not agree with results obtained by other methods. 16 references. JLG(6)

Note on the Diameter Measurement of Certain Brinell Indentations in Cold-Rolled Metal. Hugh O'Neill. *Institute of Metals, Advance Copy* No. 579, Sept. 1931, 4 pages.

The readings of the diameters of Brinell impressions in hard rolled metals may vary by as much as 4% due to the shape of the lip of the impression. The smallest diameter observed is the true diameter. "Dark-ground" illumination always gave the true diameter. 1 reference. JLG(6)

On the Investigation of the Asymmetry and Flaws in Samples of Ferromagnetic Material. (**Sur la recherche de la dissymétrie et les défauts dans les pièces ferromagnétiques.**) Jean Peletier. *Comptes Rendus*, Vol. 193, Sept. 7, 1931, pages 420–421.

An article, accompanied by one diagram, in which a description is given of a method employed for the investigation of ferromagnetic materials by magnetic means. OWE(6)

On the Elastic Extension of Metal Wires under Longitudinal Stress. L. C. Tyte. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Dec. 1930, pages 1043–1052.

The measurement of the elastic elongation of metals, especially for proving Hooke's law, can be carried out in an apparatus in which the changes of lengths of 2 wires are compared. This may be applied if the wires have the same section but different lengths and loads. If the length of one wire is half the length of the other but the load is twice that of the other, the elongation must be the same according to Hooke's law. The differences are made visible by an optical device. Details of the apparatus are described. Ha(6)

Strengthening by Reversals of Stress. (**Verfestigung durch Wechselbeanspruchung.**) W. Schwinning & E. Strobel. *Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, pages 378–381; Dec. 1930, pages 402–404.

Steel with 0.05% C and brass with 72% Cu were studied by subjecting wires of these materials to reversals of stress (bending) and then determining the ultimate tensile strength, the yield point and the elastic limit. Data collected are given graphically. More data and conclusions will be given in a concluding article. The second part of the article gives an account of the changes in structure (slip lines, grain boundaries, etc.) and the effect of heating (recrystallization) upon the structural changes observed. RFM+EF(6)

Forging Stresses, Refining Stresses and Heat Stresses. (**Schmiedespannungen, Vergütungsspannungen und Wärmespannungen.**) G. Sachs. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 43–48.

See *Metals & Alloys*, Vol. 1, July 1929, page 28. Ha(6)

Examination of Rope Wires by Tensile and Bending Tests. (**Prüfung von Seildrähten durch Zug- und Biegeversuche.**) G. Sachs & H. Sieglerschmidt. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 68–78.

The method for these tests is described and the results for steel wires and wire of other metals tabulated. See *Metals & Alloys*, Vol. 1, Aug. 1929, page 78. Ha(6)

Bearing of Present-Day Knowledge of Plastic Deformation on the Testing of Metals. (**Bedeutung der heutigen Kenntnisse plastischer Verformungsfähigkeit für die Metallprüfung.**) G. Sachs (Kaiser-Wilhelm-Institut für Metallforschung.) *First Communications of the New International Association for the Testing of Materials.* Group A. Zurich, 1930, pages 309–315. 25 references. 5 figures.

Very brief comment on the effect of cold-working on properties. Directional effects and internal stresses are touched upon. The references are to German literature. HWG(6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A. S. T. M. Research Committee on Fatigue of Metals.

Fatigue Stresses, with Special Reference to the Breakage of Rolls. FREDERIC BACON. *Engineering*, Vol. 131, Feb. 20, 1931, pages 280–282; March 6, 1931, pages 341–344.

Condensed from paper read before the South Wales Institute of Engineers, Nov. 18, 1930. See also letter by J. Selwyn Caswell on page 368 of the March 13, 1931 issue of *Engineering*. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. LFM(6f)

The Fatigue Strength of Carbon and Alloy Steel Plates as Used for Laminated Springs. R. G. C. BATSON & J. BRADLEY. *Engineer*, Vol. 151, Feb. 27, 1931, pages 231–232.

Summary of paper read before the Institution of Mechanical Engineers, Feb. 20, 1931. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. LFM(6f)

A Study of Welded Metals under Fatigue Tests. G. E. THORNTON. *Engineering Experiment Station Bulletin* No. 34, *State College of Washington*, 1930, 31 pages; *Journal American Welding Society*, Vol. 9, Oct. 1930, pages 48–66.

The object of the tests undertaken in the study herein reported was to compare the different types of welds in which a flexure of the specimen occurs when subjected to a continuous series of stress reversals. Such a condition is present in a member under continuous or spasmodic vibration. The tests were undertaken by the Engineering Experiment Station of the State College of Washington in coöperation with the mechanical engineering department of the same institution and with the American Welding Society. The field covered in this work consists of tests of oxy-acetylene welds, resistance welds and flash welds, and some work on atomic hydrogen and metallic arc-welds. In determining a policy of securing specimens, it was decided to test small specimens in fatigue and to obtain a true cross-section of the welding field by soliciting welded coupons from companies doing different types of welding. The average of these tests gives a lower result than would be obtained if one experienced man were doing all the welding with the knowledge that his welds were to be tested for data. The author believes that this cross-section of the entire field is a much better indication of what to expect from welds than the results obtained by any one individual. The author indicates that the study will be continued with tests on the different types of shielded metallic arc-welds and on specimens of all types of welds which have been uniformly heat-treated. (6f)

The Fatigue Fracture. (**Ueber den Ermüdungsriss.**) N. DAWIDENKOW & E. SCHEWANDIN. *Metallwirtschaft*, Vol. 10, Sept. 11, 1931, pages 710–714.

5 references. Tests were made to determine the effect of fatigue cracks on the tensile strength of the remaining portion of the metal. 0.15–0.20 C steel annealed at 900° C. was subjected, in a Wöhler rotating beam machine, to loads exceeding the endurance limit for various numbers of cycles. The partly cracked test pieces were then pulled in a tensile machine. In order to obtain a brittle break the tensile tests were made in liquid air. When the breaking load in kg. is plotted against the number of cycles, the curve first gradually slopes downward and at 300,000 cycles bends sharply downward. This point corresponds to the beginning of the crack. Plotted against the area of the fatigue crack, the breaking load in kg. drops very sharply in the first mm.² from 940 to 540 kg., then bends and proceeds in a sloping straight line. This shows how great the notch effect is. If the fatigue crack is polished out after it first appears, the break in the first curve is changed from 300,000 to 1,000,000 cycles. X-ray examination of the outer and intermediate zones and the unbroken core showed no difference in crystallographic orientation. A fatigue crack starts by a number of small cracks forming at not exactly the same cross section which increase in width and depth until they meet, producing the outer zone with rough surface. From then on the single crack proceeds with a smooth surface forming the intermediate zone. CEM(6f)

A Few Observations of Fatigue Tests. (**Einige Beobachtungen bei Dauerstandversuchen.**) R. MAILÄNDER. *Krupp'sche Monatshefte*, Vol. 12, Aug.–Sept. 1931, pages 242–243.

The conception of the term "fatigue test" or "static endurance test" is discussed and illustrated by an example. The definition of this term is not yet absolutely certain. The tests made were only to give a basis for further practical research. Ha(6f)

Endurance Tests of Steel Wires with Alternating Tension Loads. (**Dauerprüfungen unter wechselnden Zugbeanspruchungen an Stahldrähten.**) A. POMP & C. A. DUCKWITZ. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 5, 1931, Report No. 175, pages 79–91; *Stahl und Eisen*, Vol. 51, May 14, 1931, pages 620–622.

The experiments were made on 4 steels:

C	0.43%	0.62%	0.62%	0.83%
Si	0.17%	0.20%	0.21%	0.22%
Mn	0.41%	0.40%	0.42%	0.45%

The wires were patented and drawn as follows:

Steel	Furnace Temperature	Load Temperature
A	1000° C.	550° C.
B	1000° C.	550° C.
C-Group I.	900° C.	550° C.
C-Group II.	1000° C.	450° C.
D	1000° C.	550° C.

Diameter of wire at patenting—mm.	Number of drafts after patenting	Diameter of wire after drawing-mm.	Reduction of area %
1.2	2	0.9	44
1.6	4	0.9	68
2.1	6	0.9	82
2.9	8	0.9	90

At first the normal physical tests were made with all wires. The curves of tensile strength show the normal course of increased tensile strength with increased reduction of area and increased C content in the same groups of drafts. The number of kinds decreases with reduction of area and C content. The number of twists generally increases with the number of drafts. A special machine was developed for the alternating load endurance tests, in order to determine the initial strength. With the wires A and B, the initial strength decreases with the number of dratfs, but with wire C, Group I, and wire D, the initial strength increases first at the reductions of 44 and 68% and then decreases. In wire C, Group II, the initial strength increases up to 82% reduction. The ratios between initial strength and tensile strengths were established. Steel A has the highest ratio; steel D, the lowest one. The ratio decreases with the number of drafts but more rapidly with the low C steel than with the higher C steel. A definite relation between initial strength and tensile strength does not exist. In case a high initial strength is desired, only small reductions should be used after patenting. GN(6f)

On Fatigue Strength. (**Beitrag zur Frage der Schwingungsfestigkeit.**) W. SCHNEIDER. *Stahl und Eisen*, Vol. 51 Mar. 5, 1931, pages 285–292.

After discussing the importance of the various physical properties to the designer, the present state of knowledge on the oscillation strength is discussed. The results of investigations of the effect of the surface condition upon the oscillation strength is surveyed. An increase of the load is permissible under the application of a certain static pre-load even if notches or rivet holes are present in high quality steels. GN(6f)

Endurance Tests on Patented and Drawn Wire. (**Några utmattingsförsök med patenterad och dragen ståltråd.**) ANTON POMP, CARL DUCKWITZ & ALFRED LINDEBERG. *Jernkontorets Annaler*, Vol. 115, Aug. 1931, pages 371–403.

Wires with C contents from 0.43 to 0.83% and reduced by drawing from 44 to 90% were subjected to endurance tests with varying tension in a machine and the results were compared with tensile, bending and torsion tests. The best endurance was found in wires with low C content subjected to intermediate reduction by drawing. A good correlation was found between the bending tests and the fatigue tests, while the tensile and torsion tests gave no indication of the endurance of the wires. Endurance tests with varying tension were also performed on ropes of 42 wires. When normal heat-treating was employed (temperature of furnace 1000° C., temperature of lead-bath 550° C.), the best endurance was shown by ropes made from wire with a low C content (0.43%) and drawn 6 to 8 passes (reduction 80–90%). By modifying the heat-treatment good results are also obtained with higher contents of C. No pronounced connection was found between the different wire-tests and the endurance tests on ropes. In certain circumstances, the torsion test gives an indication if a wire is suitable for rope. The endurance machine for wire seems especially promising for the testing of spring wire. HCD(6f)

Sheaths on Underground Power Cables. D. W. ROPER. *Bulletin, Utilities Research Commission*, Vol. 2, Oct. 1931, pages 2 and 3.

Failures in oil-filled cable sheaths are discussed. Lead cable sheaths used in the telephone industry have been improved by alloying, as with Sb; the improvement is in line with the indications of laboratory endurance tests. In the use of power cable, the problem is not primarily one of small vibrations, but of relatively slow bending of large amplitude. In full scale tests in a dummy manhole, sheaths of lead alloyed with Sb, Sn or Ca have not been found superior to commercially pure Pb, so the results of laboratory tests of the type made by the telephone companies are not yet to be taken as accurate indications of serviceability for power cable sheaths. Since stress of 200 lbs./in.² or higher occur in service, the creep properties of lead sheaths are important. HWG(6f)

Notch and Corrosion Endurance Strength. (**Kerb- und Korrosionsdauerfestigkeit.**) P. LUDWIK. *Metallwirtschaft*, Vol. 10, Sept. 11, 1931, pages 705–710.

Contains 6 references. Physical tests including, besides the regular tensile and hardness tests, endurance tests with polished and notched specimens, and specimens subjected to corrosive liquids were made on 48 metals, non-ferrous, cast iron, carbon and alloy steels. The notches were 0.1–0.4 mm. deep, 60°, with a 0.05 mm. radius at the base. Other test bars had a collar with a diameter and width twice the diameter of the test piece, and fillet of 0–0.5 mm. The endurance limit of duralumin, brass, rolled bronze, cast iron and austenitic steel was hardly affected by the notch, calculated on the reduced cross section, but that of hardened steels was reduced considerably. In Cr-Ni steel an increase in the depth of the notch produced a greater lowering. In specimens with collars, the endurance limit was lowered below that of the notched test bars, especially if the fillet was small. A Cr-Ni steel of 108 kg./mm.² tensile strength had an endurance limit with polished test bar of 54 kg./mm.² and with a collar without fillet of only 22 kg./mm.². The comparatively small influence of notches on the endurance limit of cast metals is due to internal porosity which acts as notches and causes a low endurance limit even in polished test bars. The notched endurance limit, rather than the lowering due to notches, is of importance in evaluating the properties of metals. The ratio of endurance limit in torsion to the endurance limit in bending of rolled and forged metals was 0.575 regardless of the heat treatment. The effect of notches on torsional and bending endurance limits was in the same proportion. In cast metals the ratio was much higher. The corrosion endurance tests were made with tap water, natural and synthetic seawater in the presence of air. It was found that the usual 10,000,000 reversals were not enough under these conditions and that the results were indefinite. The corrosion endurance limit of most of the metals examined was extremely low. For instance, the highest results for light metals was 7 kg./mm.² and for steel, 14 kg./mm.². α brass gave better results. In stainless V2A steel, the effect of seawater cut the endurance limit in half, although the surface was not attacked. Heat treatment hardly increases the corrosion endurance limit over that of the annealed metals and, therefore, the drop is greatest in hardened steels. A Cr-Ni-W steel of 162 kg./mm.² tensile strength had a corrosion endurance limit of only 12 kg./mm.². In corrosion endurance tests the fracture of pure Al and soft steel was usually intragranular. CEM(6f)

Endurance of Steel Depends on Structure, Strength and Ductility. Correspondence from EINAR ÖHMAN, Stockholm, Sweden. *Metal Progress*, Vol. 20, Sept. 1931, page 88.

The writer reports results of A. Lundgren on relation between fatigue and ultimate strength as affected by change in heat treatment and the ductility as measured by reduction in area in a tensile test. WLC(6f)

Increase of Endurance Limit of Bolt-Threads by Cold-Working the Surface. (**Die Steigerung der Schwingungsfestigkeit von Gewinden durch Oberflächendrücken.**) H. ISEMER. *Mitteilungen des Wöhler-Instituts*, No. 8, 1931, 64 pages, 12 references, 21 figures. Published by N. E. M. Verlag, Berlin. Price 4 R.M.; *Metallwirtschaft*, Vol. 10, Sept. 11, 1931, pages 714–717.

Two hardened steel rollers, shaped to fit into the groove at the base of the threads of a threaded test bar were mounted in a frame and backed up by calibrated springs. By mounting the frame on the bed of a lathe and running the rollers back and forth, usually 15 times, the groove was work hardened. It was necessary that the thread be accurately cut in order that the rollers make proper contact. The pressure required for the best degree of work hardening varies for different materials. No record was made of the increased surface hardness produced, the hardening being expressed only in terms of pressure on the rollers.

Using a rotating beam specimen so loaded that the maximum stress came on the work-hardened, threaded section, and leaving some threads unworked at the location of lower stresses, the bar was loaded and run to fracture. From the location of the break the stress at that point was calculated and comparison made between the stress necessary to break the bar from fatigue at worked and at un-worked threads.

Medium carbon steels gave about 20–25% increase due to cold-working of the threads at suitable pressures. A steel of 0.93% C, worked by only three passages of the rollers, showed very little improvement, but this may be due to imperfect threads. A steel of 0.30% C, 0.95% Cr, 4.2% Ni, 800–850° C oil, 620° C. draw showed some 45 to 65% increase after working with rather high pressure on the rollers, depending on the pressure used. Lautal improved some 30%. A 58% Cu, 2½% Pb brass showed some 15 to 20% improvement.

No simple relation appears between the damping ability of the materials and the improvement obtained by work-hardening the threads. On damping test, two bars of the same type of steel, not checked for analysis and mechanical properties, showed entirely different types of curves.

HWG+CEM(6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Definition and Determination of "Free Cyanide" in Electroplating Solutions. W. Blum. *Preprint, Transactions Electrochemical Society*, Vol. 60, Sept. 1931, pages 21–26.
A definition is proposed for the American Standards Association: "The free cyanide in a electroplating solution is the excess of alkali cyanide above the minimum required to give a clear solution." A volumetric method is also proposed to determine this "free cyanide" by a titration against a standard solution made of a salt of the same metal as is to be deposited from the bath. LCP(7a)

High Speed Nickel Plating as Practised in England. Ernest R. Canning. *Metal Industry*, London, Vol. 39, July 3, 1931, pages 13–14.
Paper read before American Electrochemical Society, Birmingham, Ala. Apr. 23–24, 1931. See *Metals & Alloys*, Vol. 2, July 1931, page 130. PRK(7a)

Distribution of Crystals of Chromium Electrodeposited in Thin Plates. D. T. Ewing, H. E. Publow & C. D. Tuttle. *Michigan Engineering Experiment Station, Bulletin* No. 33, 1930, 20 pages.
The Bulletin contains 33 photo-micrographs of the steels used as basis metals, and of the deposits obtained. The investigation was undertaken for the purpose of studying the nature of the formation of crystals of metals which are deposited electrolytically. The work is limited to the formation of crystals during the initial stages of deposition in order to note the effect of the composition and the physical condition of the basis metal upon the nature of the deposit. The work was further limited to the composition of the plating solution, current density and certain other factors, but the temperature and time were varied. The experimental work includes the study of the crystal growth of Cr deposited upon carefully polished surfaces of steels with C contents of 0.20, 0.85, 1.20 and 1.50% and on Armco Iron. The time of plating varied from 15 seconds to 8 hours and temperatures of 45° and 55° were used. The Cr plating solution contained 250 g. CrO_3 and 2 g. $BaSO_4$/liter. The initial Cr deposits were not microscopically uniform; invariably the Cr deposited first upon the cementite and spread rapidly to the ferrite within the pearlite areas. This effect was noted in the samples of low C content as well as in those where cementite was concentrated within the crystal boundaries. Cu and Ni were found not to deposit selectively but evenly over the surface of the steels, and Cr deposited over Cu and Ni was uniformly deposited over the metal surface. The color of the deposits changed during the first stages of deposition; up to 15 seconds the deposits were dull, after which they became brighter. At the higher temperature (55°) the changes noted above were accelerated and the basis metal was more uniformly covered in shorter time. The higher temperature also decreased the tendency for Cr to deposit selectively. Short cracks were found to form after the first few minutes of deposition. No correlation was found between the cracks and the crystal boundaries of the basis metal. (7a)

The Progress of Chrome-Plating during the Last Years. (Die Entwicklung der Verchromung in den letzten Jahren.) W. Birett. *Werkstattstechnik*, Vol. 25, Mar. 1, 1931, pages 135–140.
While no principal change in the technique of chrome plating is noted, several important details have been studied more thoroughly and the limitations for the application of the method more exactly circumscribed. It has been recognized that only solutions of the type of chromic acid in sulphuric acid are suitable for plating and that supervision should be the permanent task of a works laboratory. Chrome plating alone is not a protection against corrosion as the deposit is too porous on account of the development of hydrogen. Nickel plating as an intermediary layer on which chrome is deposited is, at present, the recognized method for obtaining a protection against corrosion. The question of safety of chrome deposits against chemical action is not yet sufficiently solved. In any case, experience has shown that well polished surfaces before plating guarantee a much greater protection against attack. A field where chrome plating has proved of great value is the plating of wood-working tools, especially millers (which showed a much longer life and needed less regrinding). This is done only at the front and not on the cutting edges. The accumulation of chromic acid in the vapors above the baths which are usually condensed on iron grates has proved to be very costly. On the other hand, the prevention of the vapor by covering the bath with protective films of oils is applicable only when simple objects of straight lines are to be plated as otherwise the oil might stick to holes, protrusions, etc., and prevent the deposition of metal. Particular care should be given to the exhaustion of the explosive oxy-hydrogen gas which should be exhausted with 300–500 times its amount of air to prevent self-ignition. Ha(7a)

The Porosity of Electroplated Chromium Coatings. W. Blum, W. P. Barrows & A. Brenner. *Bureau of Standards Journal of Research*, Vol. 7, Oct. 1931, pages 697–711.
Various methods for detecting porosity of Cr coatings were found to yield consistent results. Very thin deposits contain round pores. As the thickness is increased the porosity decreases to a minimum, after which an increase in thickness is usually accompanied by the formation of cracks, either parallel or random. The well-known Cu deposition method for detecting the porosity depends upon the fact that Cu will deposit only in pores or cracks and not on the Cr. This test was made semiquantitative by measuring either the average apparent current density, or the weight of Cu deposited in 2 minutes at 0.2 v. The following conclusions are based on such measurements. Their practical significance will be determined by exposure tests now in progress. The porosity usually increases on standing. This increase is accelerated by heating to 200° C. Changes in the composition of the solution have no marked effect on the porosity. An increase in the temperature of deposition, for example to 65° C., instead of the usual temperature of 45° C., greatly decreases the porosity, especially of thick coatings. At any given temperature, the porosity is increased by raising the current density. Deposits on Ni are less porous than those on other base metals. This difference is at least partly due to the greater ease of securing a bright finish on Ni prior to the Cr plating. WAT(7a)

The Application of Electrodeposited Metals to Engineering. C. H. Faris. *Machinery*, London, Vol. 37, Feb. 28, 1931, pages 701–703.
Paper read before the Manchester Association of Engineers. Account of the Fescol electrodeposition process as applied to the building up of worn engineering parts. The outstanding characteristic of the process is the high degree of adhesion obtained between the basis metal and the electrodeposited plating. Some details are given of a report by the National Physical Laboratory on the adhesive or shear stress of Fescolized samples. The hardness of the deposited metal is regulated to conform to the conditions of wear for which the part is designed. Brief reference is also made to the applications of thinner nickel deposits for the plating of food utensils, steam parts and other articles working under corrosive conditions. Ha(7a)

The Electro Deposition of Silver from Argentocyanide Solutions. Part II. Samuel Glasstone & Edward B. Sanigar. *Transactions Faraday Society*, Vol. 27, July 1931, pages 309–312.
Reduction in polarization is accompanied with bright deposits obtained with the presence of potassium cyanate in stock Ag solution. Other brightening agents as carbon disulphide also lower polarisation. PRK(7a)

Electrometallurgy (7b)

The Refining of Copper by the Series System. (Le raffinage du cuivre par le système "series.") M. Altmeyer. *Cuivre et Laiton*, Vol. 4, Aug. 30, 1931, pages 375–378; Sept. 15, 1931, pages 401–405.
A detailed description of the works of the Baltimore Copper Smelting and Rolling Co., Baltimore, Md., and of the Nichols Copper Co., Laurel Hill, N. Y., where, at present, the electrodes are all connected in series instead of in parallel. Ha(7b)

The Utilization of Secondary Reactions in Igneous Electrolysis. (L'Utilisation des Réactions Secondaires en Électrolyse Ignée.) L. Andrieux. *Chimie et Industrie*, Vol. 25, May 1931, pages 1047–1057.
Borides are prepared by electrolytic methods at 1000°. The electric furnace has failed to do this except at higher temperatures. Borides of Ti, Ta, Cb and rare metals can be prepared in this manner. MAB(7b)

Contributions to the Chemistry of Beryllium. I. Electrolysis in Non-Aqueous Solvents. II. Electrolysis of Beryllium Compounds in Organic Nitrogen Derivatives. Harold Simmons Booth & Gilberta G. Torrey. *Journal Physical Chemistry*, Vol. 35, Sept. 1931, pages 2465–2477, 2492–2497.
Paper dealing with work preliminary to an investigation of the preparation of metallic Be. A variety of Be salts have been dissolved in non-nitrogenous, non-aqueous media and the behavior of the solutions on electrolysis observed. None of the solutions investigated have proved to be satisfactory sources of metallic Be. Solutions of various Be salts in organic derivatives of ammonia have been electrolyzed; most of them form gelatinous, colloidal substances which render the practical separation of metallic Be from these solvents problematical. OWE(7b)

Investigation of Anodes for Production of Electrolytic Zinc. H. R. Hanley, C. Y. Clayton & D. F. Walsh. *Transactions American Institute Mining & Metallurgical Engineers*, 1930, pages 275–282.
Includes discussion. See *Metals & Alloys*, Vol. 1, June 1930, page 565. (7b)

Gold and Silver Recovery from Tin Slime. John B. Kasey. *Engineering & Mining Journal*, Vol. 132, Sept. 14, 1931, pages 217–218.
The tin slime dealt with in this work originated from the electrolysis of scrap brass and bronze, containing small amounts of Ag and Au and larger amounts of Pb, Sn, Zn, Ni, iron oxides and admixed sand. The wet slime, which originated in a solution of H_2SO_4, consists of sulphates, basic sulphates, metallics and free acid. The problem in treating the slime is to separate and recover 4 different metals and alloys: an alloy of Au and Ag; pure Cu; a white-metal alloy of Sn, Pb, Sb and Ni or its salts. The recovery of Au and Ag are alone discussed. Cu in the slime is made the collector. Experimental work is outlined. WHB(7b)

The Rapid Determination of Current Efficiency in the Electrolysis of a Zinc Sulfate Electrolyte. F. E. Lee & A. H. W. Busby. *Preprint, Transactions Electrochemical Society*, Vol. 60, Sept. 1931, pages 1–7.
Cathode efficiency of zinc sulphate electrolyte from leaching of roasted blende is determined indirectly by measuring the H given off per ampere-hour at the cathode, thus, the cathode efficiency for Zn is equal to 100 minus cathode efficiency for H. This method checks closely with that based on the weight of zinc deposit, but it takes only 45 mins. as against several hours required by the latter method. LCP(7b)

Technical Applications of the Electrodeposition of Metals. H. J. T. Ellingham. *Journal Institute of Metals*, Vol. 47, Sept. 1931, pages 1–5.
The paper summarizes some of the main features of the various electrolytic metal deposition processes and indicates the general principles on which they are based and the scope of their application. 3 tables are given in each of which the metals are arranged in the electrochemical series, starting with the basest and ending with the noblest metal. The baser the metal, the more readily it is oxidized or attacked by dilute acids, but the less easily it is obtained in the free state by chemical reduction of its oxide or salts. The first table includes metals which react with water and cannot, therefore, be deposited from aqueous solutions; these are Li, Rb, K, Sr, Ba, Ca, Na, Mg, Be, Al, Ce, rare earth metals. The second table contains metals which can be deposited from aqueous solutions. Mn, Zn, W, Cr, Fe, Cd, In, Tl, Co, Ni, Sn, Pb, Sb, Bi, As, Cu, Ag, Hg, Pd, Pt, metals of the Pt group, Au belong in this table. The third table contains metals of variable or undefined electrochemical character, whose positions in the electrochemical series are not known. Most of them can, however, be electrodeposited from molten salt baths, e. g., Ti, Zr, Th, U. Very little is known about the possibility of electrodepositing V, Nb, Ta, Mo in this manner. The tables also give the solutions from which they can be extracted, in which they can be electrolytically refined and electrodeposited. 15 references. Ha(7b)

Cathodic Forms of Electrolytic Tin. (Ueber kathodische Abscheidungsformen des Zinns.) F. Foerster & H. Deckert. *Zeitschrift für Chemie*, Vol. 36, Nov. 11, 1930, pages 901–923.
Crude *m*-cresolsulphonic acid in the electrolysis of a H_2SO_4 solution of $SnSO_4$ can repress the tendency of the Sn to form needles growing perpendicular to the surface of the cathode, and to form the Sn precipitation in a smooth and even surface. The by-products formed in the sulphonation of *m*-cresol influence the separation of the Sn because they are absorbed by the precipitate. The amount and nature of the by-products depend on temperature and time of sulphonation. Above 120° C., colloidal by-products are also formed. When the concentration of impurities is low, the Sn deposit is needle-like to spongy. As the concentration increases, the deposit becomes granular or smooth and, when high, the crystals become fine and arranged in unordered patterns. Finally, the plated Sn becomes structureless and milk-white in color and a point is reached when colloidal material precipitates with the Sn. The absorption is less at high temperatures and greatest at low temperatures. Ha(7b)

Germanium in Relation to Electrolytic Zinc Production. U. C. Tainton & E. T. Clayton. *Metal Industry*, London, Vol. 37, Sept. 5, 1930, pages 229–230.
Paper presented before the American Electrochemical Society at St. Louis. See *Metals & Alloys*, Vol. 1, Aug. 1930, page 686. VSP(7b)

The Electro-Deposition of Copper in the Presence of Gelatin. Robert Taft & Harold E. Messmore. *Journal of Physical Chemistry*, Vol. 35, Sept. 1931, pages 2585–2618.
The authors have studied the effect of introducing increasing amounts of gelatin into solutions of copper sulphate upon the form of the cathode deposit. In these experiments the concentrations of gelatin and of copper sulphate, the current densities and the temperatures have been varied. The authors believe that the most direct explanation of the phenomena observed requires the assumption that the Cu deposited by the current adsorbs gelatin upon its surface. Measurements of the magnitude of the cathode polarization in the cell $Cu/CuSO_4$, Gelatin/Cu have been made. The results obtained are taken by the authors to indicate that complex cations are formed between cupric ion and gelatin but that the electro-chemical process occurring at the cathode is primarily discharge of cupric ion. OWE(7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

The Attack on Mild Steel in Hot-Galvanizing. Edward J. Daniels. *Institute of Metals, Advance Copy* No. 566, Sept. 1931, 17 pages; *Korrosion und Metallschutz*, Vol. 7, Oct. 1931, page 251.
The rate of attack of mild steel by molten Zn was determined by immersing steel samples in various grades of Zn and Zn alloys at various temperatures stripping the coating with a solution of H_2SO_4 plus As_2O_3, and determining the loss in weight. There was little difference in the loss of weight in high-grade and less pure Zn. Below 500° C. the loss in weight was proportional to the square root of the time, while above this temperature the loss was directly proportional to the time. Microscopic examination showed that below 500° C. a continuous coating of $FeZn_7$ protected the steel from subsequent attack, but that when this temperature was exceeded the layer of $FeZn_7$ was porous and furnished little protection. Small amounts of Al and Sb in the Zn slightly increased the rate of attack. The steel was rapidly dissolved in Zn-Cd alloys which was found to be due to the Cd preventing the formation of a continuous layer of $FeZn_7$. The tests were taken to indicate that a galvanizing pot should have a very long life if no part of the pot was heated to above 480° or 500° C. Examination of failed pots showed the presence of alloy layers similar to those observed in the samples. 9 references. EF+JLG(8)

Surface Protection by Means of the New Homogen-Pistol of Schoop. (Der Oberflächenschutz mittels der neuen Homogen-Pistols von Schoop.) Alf. Karsten. *Oberflächentechnik*, Vol. 7, Sept. 16, 1930, pages 173–175.
Fine metallic powder, as zinc, tin, nickel, also tungsten or silver, is driven by compressed carbonic acid from a tank to an oxy-acetylene flame. The pressure of 6–7 atmospheres imparts to the metal dust a velocity of about 25 ft./min. so that the body to be protected is covered with a very uniform layer of metal which adheres firmly. Not only metals but any other material can be metalized by this method. A few examples are illustrated. Ha(8)

Mottled Tinplates. J. C. Jones (University College, Swansea). *Iron & Steel Institute, Advance Copy* No. 11, Sept. 1931, 11 pages; *Iron & Coal Trades Review*, Vol. 123, Oct. 2, 1931, pages 487–489.
Mottled or dull tinplate only occurs when high Sn yields are sought. It was found that under some conditions mottling resulted in some steels and not in others. Macrostructures of bars from which the plates were produced indicated that the bars with the thickest skin were the least susceptible to mottling. Mottling is also dependent on conditions in the Sn pot, and was found to be produced by the flux rather than by the Sn. An NH_4Cl flux was found to give bright sheets when substituted for a $ZnCl_2$ flux that was producing mottled sheets. The NH_4Cl flux, however, would not remove grease as readily as the standard flux. It was concluded that the better action of NH_4Cl was due to a greater frothing rather than to a greater reactivity. Ha+JLG(8)

Investigations on the Occurrences during Zinc Coating. On the Solubility of Pure Iron in Molten Zinc. (Untersuchungen über die Vorgänge beim Verzinken. Ueber die Löslichkeit von reinem Eisen in geschmolzenem Zink.) H. Grubitsch. *Stahl und Eisen*, Vol. 51, Sept. 3, 1931, pages 1113–1116.
The solubility of Armco-iron in chemically pure Zn is very slight up to 470° C. and practically independent of the time. A maximum of solubility is observed at 515° C., but the solubility increases again at higher temperatures. The dependence of the solubility upon the time then rapidly decreases. GN(8)

Temperature and Purity of Zinc as Factors in the Production of Galvanizer's Dross. Wallace G. Imhoff. *Iron & Steel of Canada*, Vol. 14, June 1931, pages 93–94, 107.
Discussion of conditions under which galvanizer's dross is produced in plant operation, indicating the importance of the quality of the Zn used and the temperature of the bath. The results of experiments made to answer the question, "Can dross be made from pure Zn at any temperature?" are described. The article is accompanied by 3 photographs. The conclusions reached are that heat alone will not produce dross or Zn-Fe alloy in pure Zn, and that, when no Fe is present, even temperatures far above those used, or found in hot galvanizing, will not produce dross or Zn-Fe alloy crystals. OWE(8)

The Use of Tin in the Galvanizing Bath. Wallace G. Imhoff. *Heat Treating & Forging*, Vol. 17, July 1931, pages 675–678.
The addition of Sn to the galvanizing (Zn) bath has the tendency to cleanse the bath of oxides, scurf and dirt. The coating assumes the Sn spangle: a fern-like, large star-like crystal-forming growth. The amount of Sn added varies with the different kinds of work; large additions will almost close up the spangle and show a dull, solid coating. Sn as an addition to baths that contain an excess of Al is especially beneficial because Sn combines with Al, thus eliminating the oxide skimmings. An excess of Sn may produce a tarnish over the coating. Several bath compositions for various purposes and materials to be galvanized are given. Ha(8)

The Tinplate Industry. D. Griffiths. *Journal Society Chemical Industry*, Vol. 50, May 22, 1931, pages 431–437.
A brief review covering the history, metallurgy, manufacture and products of the tin plate industry. VVK(8)

The Protection of Metals by Metallic Films. Ernest S. Hedges. *Journal Society Chemical Industry*, Vol. 50, Sept. 18, 1931, pages 768–772.
2 kinds of protection may be afforded to iron by metallic films. When the protecting metal is less noble than the base metal such as in the zinc-coating of iron, the protection is partly electrochemical; the Zn, in the presence of an electrolyte becoming the anode and corroding, the Fe becoming the cathode and remaining unattacked. When the protecting metal is more noble than the base metal, as Fe coated with Cu, the protection afforded is mechanical like that offered by a coat of paint excluding the corrosive agencies and remaining effective only as long as they completely cover the surface. Protective metallic films must have: ability to undergo deformation without peeling, adherence to the base, resistance to abrasion, brightness and general appearance, and paint-holding properties. Protective metals can be applied by hot-dipping (Zn, Sn and Pb), electroplating (Zn, Cu, Ni, Cr etc.), metal spraying (Zn, Al), and cementation (sherardising, chromising and calorizing). All of these processes are discussed. VVK(8)

Alclad and the Aluminum Coating of Aluminum Alloys. (Le revètement des alliages d'aluminium et l'Alclad.) P. M. Haenni. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 575–585. 18 figures, 29 references.
The value of the Al coating of duralumin for protection against intercrystalline corrosion, the electrolytic protection afforded by the coating and the mechanical properties of Alclad are reviewed. No new information is included. HWG(8)

Effects of Cadmium Vapors. (Kadmiumdampf-Einwirkung.) L. Schwarz & W. Deckert. *Zentralblatt Gewerbehygiene und Unfallverhütung*, Vol. 18, No. 3, 1931, page 66.
Certain injurious effects which were experienced in spraying of Zn coatings are ascribed to low contents of Cd in the zinc (0.12% in the case described). Purer zinc dust or exhaustion of the vapors is recommended as the remedy. Ha(8)

INDUSTRIAL USES & APPLICATIONS (9)

Some Factors Influencing the Sizes of Crankshafts for Double Acting Diesel Engines. S. F. Dorey. *Northeast Coast Institution of Engineers and Shipbuilders Transactions*, Vol. 47, June-July 1931, pages 229–316.
The general procedure for determining the diameter of a shaft subjected to combined bending and torsion is to calculate the equivalent bending or twisting moment and to use a constant working stress irrespective of the type of engine. In the method put forward in this paper a different stress is allowed for each type of engine depending upon the ratio of twisting moment to bending moment and also on the fluctuations of shear stress at the most severely stressed crank. Thus the diameter of a crank-shaft subjected to large fluctuations of torque is ascertained by allowing a lower working stress than in the case of a shaft subjected to small fluctuations yet having the same maximum torque. The method indicated in the first part of the paper shows how the strength of the crankshafts can be ascertained from a knowledge of the fatigue properties of materials at various ranges of stress, and has been used to determine suitable diameters of crankshafts for double-acting Diesel engines, based on previous experience with steam reciprocating engines and single-acting Diesel engines. The results indicate that for engines having a small number of cylinders the working stress permissible should be appreciably less than for engines having a large number of cylinders for the same factory of safety. For two-stroke-cycle double-acting engines having a large number of cylinders the maximum working torsional stress due to combined twisting and bending suggested is somewhat in excess of that usually adopted in existing steam engines and single-acting Diesel engines, viz., 7000–7500 lbs./in.² as against 5600 lbs./in.² and as a result some comments have been made relative to the shrinkage grip for built shafts. WAT(9)

Catalytic Reactions of Sulfur Compounds Present in Petroleum. I. High Sulfur Naphtha in Contact with Nickel and Iron Catalysts. J. C. Elgin, G. H. Wilder & H. S. Taylor. *Industrial & Engineering Chemistry*, Vol. 22, Dec. 1930, pages 1284–1290; **II. Pure sulfur Compounds in Hydrocarbon Materials in Contact with Nickel Catalysts.** Joseph C. Elgin. pages 1290–1293.
Five references. It is shown that a reduction in the sulphur content of naphthas is effected by passage, in the vapor phase, over a nickel or an iron catalyst, nickel being the more efficient. Sulphur may be completely removed in contact with the initially sulphur-free nickel catalyst, but the catalyst undergoes a decrease in activity as sulphurization proceeds. Nickel and iron catalysts do not absorb from the liquid phase all sulphur present in the naphthas. The second part of this article has four references. The results indicate that the sulphur content of naphthas containing relatively large proportions of thiophene sulphur will be the most difficult to reduce by catalytic methods. MEH(9)

Aluminum and Aluminum Alloys as Materials of Construction in the Chemical Industry. (Aluminium und Aluminiumlegierungen als Baustoffe in der chemischen Industrie.) Dornauf. *Metallbörse*, Vol. 20, Aug. 30, 1930, page 1913.
Experience in using pure Al, Al-Si and Al-Mg alloys is described. Duralumin and Al-Cu are not useful, but must be plated with pure Al. Pure Al (99.5–99.8%) is used to handle N acids and bases, concentrated HNO_3, organic compounds and in the dairy, brewing and food industries. Its disadvantages are poor casting properties and low tenacity. Al-Si and Al-Mg alloys have twice the strength of pure Al, cast well, and have as high chemical corrosion resistance. The Si alloy is used for valve bodies, stirrers, mixers, filter frames, retorts, evaporators, acid equipment and contact apparatus and the Mg alloy for pump cylinders, elevator buckets and stills. Often laboratory corrosion tests give results different from actual practice, due to voltage produced under liquids by contact with other metals or due to welding. WHB(9)

Lightening of Rolling Stock by Use of Aluminum Alloys. (La legerement du materiel roulant par l'emploi des alliages d'aluminum.) A. Dumas. *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Apr. 1931, pages 193–200.
General discussion of aluminum alloys used in railroad construction. GTM(9)

Metals for Dairy Utensils. A. Eyles. *Metal Industry*, N. Y., Vol. 29, Oct. 1931, page 435.
The metals for use in equipment for handling milk products are discussed. PRK(9)

Pure Aluminum vs. Alloyed Aluminum for Transmission Lines. Correspondence from A. J. Field (British Aluminium Co., Ltd.). *Metal Progress*, Vol. 20, Oct. 1931, page 85.
The writer stated the value of steel cored Al transmission lines is shown in 20 yrs.' satisfactory service. WLC(9)

Aluminum Alloys for Transmission Lines. F. Giolitti. *Metal Progress*, Vol. 20, Oct. 1931, pages 85–86.
The writer describes the use of Al alloys in Italian transmission lines. WLC(9)

Trend Toward Standardization of Aluminum Alloys. F. Giolitti. *Metal Progress*, Vol. 20, Sept. 1931, pages 86–87.
The writer discusses various compositions of Al alloys and their application to automotive work. WLC(9)

Aluminum Alloys and Their Possibilities for Application in Rolling Stock for Railways, Tramways and Buses. (Les alliages de l'aluminium et leurs possibilités d'applications dans la construction du matériel roulant des chemins de fer, des tramways et des autobus.) M. Hug. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 587–590.
Examples of weight saving through use of Al alloys and some account of the extent to which they are used in rolling stock all over the world. HWG(9)

Applications of Nickel in the Electrical Industries. (Les applications du nickel dans les industries electriques.) M. Ballay. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 471–492, 21 references.
Résumé dealing with electrical resistivity, magnetic and thermo-electric properties of nickel alloys, use of Ni steels in alkaline storage batteries and brief comment on Invar and Konel. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 176. HWG(9)

The Use of Vanadium Steels in American Railroads. (L'emploi des aciers au Vanadium dans les chemins de fer americans.) R. Cazaud. *Aciers Speciaux, Métaux et Alliages*, Vol. 6, Apr. 1931, pages 189–191.
The use of V steel is actually very important in U. S. for construction of locomotive and railroad material. C-V steel used consisted of 0.5% C, 0.80% Mn and 0.20% V also with 1.0% Cr. GTM(9)

Corrosion Resistant Steels. R. L. Duff (Standard Oil Development Co.). *American Society for Steel Treating, Preprint* No. 9, 1931, 6 pages.
Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The author discusses the application in the oil refineries for the new corrosion resistant steels. Study of each steel and each problem is emphasized. WLC(9)

HEAT TREATMENT (10)

Metallurgical Control for Cutting Tools. W. R. Breeler. *Heat Treating & Forging*, Vol. 16, Sept. 1930, pages 1185–1188.
Heat treating methods for these products must be very uniform. Microphotographs show correctly and incorrectly treated specimens due to fluctuations in heat. Ha(10)

Heat Treatment in Forging Steel. B. Saunders. Crosby-Lockwood & Son, London, 1930. Cloth, 5 × 7½ inches, 117 pages. Price 5 sh.
This is a small manual for the practical blacksmith. As a sample of the directions given, we may cite the following. "Springs are tempered by reheating until sparks are produced when a piece of ash or hazel wood is rubbed on."
Nitriding is mentioned. It is stated that "Nitrogen is deposited by chemical action in special electric furnaces, upon the surfaces of bright finished parts during periods ranging up to 3 or 4 days in length." There is no hint that any special composition of steel is required.
The author says "The best material for the production of drop forgings or stampings is very mild steel or wrought iron, in which the carbon is below 0.50%."
While the author refers to "red heat," and gives his directions for drawing in terms of temper colors, he devotes one chapter to pyrometers. The book is not written for the metallurgist. Indeed, the chief point in reviewing it is so that a metallurgist who might think from the title that it contained information for him, will know that it does not. It seems doubtful if the blacksmith will get much out of it either.—H. W. Gillett(10)-B-

Importance of Correct Heat Treatment of Aircraft Parts. F. T. Sisco. *Houghton's Black & White*, Vol. 3, Mar. 1931, pages 4–8.
To turn out absolutely reliable work, every factor entering into the heat treatment of aircraft parts must be scientifically controlled. Correct design and suitable materials are other important conditions. 3 main causes for failures are the hardening cracks originating in a notch, weakness due to temper brittleness and non-uniformity of heat treatment. They are more fully discussed and the proper methods for avoiding them are explained. Ha(10)

Heat-Treatment of Rails. (Les traitements thermiques des rails de chemins de fer et de tramways.) H. Viteaux. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 405–418.
The Sandberg, Neuves-Maisons, Nadiejinsky, Maximilian-Hütte-Rosenberg and the Kenney-Bethlehem processes are briefly described. Laboratory tests on Sandberg and Neuve-Maisons process rails are tabulated. Stanton repeated impact tests (distance of drop of the tup not stated) showed an average of 3500 blows to fracture for specimens from untreated rails, and 10,500 for treated rails, though the single blow impact averages were lower (1.87 against 2.40) for the treated rails. Service results on heat-treated rails have shown improved wear resistance and the scanty evidence so far available on fissures also indicates promise. Viteaux believes that heat-treated converter steel is a proper material for rails. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 219. HWG(10)

The Theory of Recrystallization. (Zur Theorie der Rekristallisation.) G. Tammann. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 117–138.
See *Metals & Alloys*, Vol. 2, Jan. 1931, page 9. HWG(10)

The Decarburization of Carbon Steels by Heating in Salt Baths. (Ueber die Entkohlung von Kohlenstoffstählen bein Erhitzen in Salzbädern.) A. Seuthe & E. H. Schulz. *Mitteilungen Forschungs-institut Vereinigte Stahlwerke*, Vol. 2, No. 4, 1931, pages 61–76; *Stahl und Eisen*, Vol. 51, June 25, 1931, pages 791–793.
In an effort to elucidate the reasons for the surface decarburization of C steels when heated in salt baths, the authors heated samples of a C steel (C: 0.84%, Si: 0.03%, Mn: 0.25%, P: 0.02%, S: 0.03%) for ½, 1 and 3 hrs. at temperatures between 800° C. and 1000° C. in salt baths of NaCl, NaCl + KCl (1:1), NaCl + $BaCl_2$ (1:1), NaCl + $CaCl_2$ (1:1), and $CaCl_2$ + $BaCl_2$ (1:1). After heating, the C content of the 0.5 mm. thick outer layer and the C content of the core was determined. The results are as follows:

Type of salt	Decarburization of outer zone %	Total Decarburization %	Decrease of weight	Depth of decarburization zone %
NaCl	18.5	3.99	2.83	0.080
NaCl + KCl	17.5	4.02	2.82	0.076
NaCl + $BaCl_2$	12.1	2.71	2.06	0.058
NaCl + $CaCl_2$	30.5	5.10	2.30	0.120
CaCl + $BaCl_2$	24.2	5.00	1.32	0.140

The mixture of 50% NaCl + 50% $BaCl_2$ shows the smallest decarburization, next NaCl + KCl and NaCl, which show practically the same decarburization of about 50% more than NaCl + $BaCl_2$. The decarburization was found to be due to the air O which is dissolved in the salt melts. This O reacts directly with the C of the steel; on the other hand, iron oxides are formed during the heating. Since the amount of oxides formed increases with the weight of the samples treated, the decarburizing effect of the salt melts increases gradually. Sulphates present in the salts are of minor importance in bringing about decarburization. The chlorides mentioned above do not decarburize in a direct way. GN(10)

The Surface Decarburization of Steel. W. E. Jominy. *Heat Treating & Forging*, Vol. 17, July 1931, pages 684–688, 725; Aug. 1931, pages 781–782.
An abstract of an investigation by the American Gas Association as to the cause of the often troublesome decarburization in hardening operations which have to give maximum surface hardness. The work done on this subject by former investigators is reviewed, and, since no conclusive results had been obtained, new tests on the influence of gases were undertaken. The test methods are described and results with steam, air, CO_2, N, H and mixtures of these are given in tabulated form. 9 conclusions can be drawn. Among them, the most important is that, beside moist H, CO_2 produces the greatest decarburization at temperatures of 1350° F. and above. When mixed with 50% steam, this deleterious action was greatly reduced. Absolutely pure N does not cause decarburization; commercial N, however, will do it. The pressure of the atmosphere and the rate of flow, also, have a certain influence. The more strongly oxidizing the furnace atmosphere is, the less is the tendency to decarburize. It is recommended that, besides the prevention of decarburizing, the prevention of scaling should also be attempted. This can be accomplished by heating in pure N. For details, the paper must be referred to. Ha(10)

Aluminum Alloys and Their Treatment. J. W. Urquhart. *Heat Treating & Forging*, Vol. 17, Feb. 1931, pages 155–156; Mar. 1931, pages 260–262.
The marked differences in the heat treatment of steel and light metal alloys are set forth. The latter are not so easily stabilized; the heating phase has to be continued for hours. While tempering is a rapid phase in steel treatment to partially soften the extreme hardness secured by rapid cooling, the tempering of the light alloy has to harden it still further. The constitutional changes occurring during the treatment of different light alloys, their composition and physical properties, mode and temperature of pouring and the processes of heat treatment are briefly reviewed. Ha(10)

Heat Treatment of Automotive Steels. J. W. Urquhart. *Heat Treating & Forging*, Vol. 16, Oct. 1930, pages 1295–1299; Nov. 1930, pages 1412–1416, 1418.
Present improved status in the heat treating practice of automobile springs, fenders and gears. Data on low C steels, Cr-V steels, Ni-Cr steels. Table giving the composition of 12 British steels (Ni, Ni-Cr and Ni-Cr-Mo) used for springs and gears. Ha(10)

Heat Treating by Program Control. S. A. Smith. *Heat Treating & Forging*, Vol. 16, Sept. 1930, pages 1163–1164; Oct. 1930, pages 1281–1284.
Recommendations and outline of a program for identification, handling and heat treatment of steel during the entire manufacturing process. Ha(10)

Forging and Heat Treating Departments of the Pennsylvania Railroad. C. I. Snowberger & E. Hoenstine. *Heat Treating & Forging*, Vol. 16, Sept. 1930, pages 1140–1144, 1155.
The equipment and methods employed in the forging and heat-treating departments of the Pennsylvania Railroad at Altoona, Pa., for the production of locomotive parts are described and illustrated. Ha(10)

Heat Treatment of Non-Ferrous Metals. A. H. Vaughn. *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 1036–1041.
Description of a few types of electric furnaces for heat treatment of brass and copper and light metals of the aluminum type. The advantages of electric heating, especially for continuous production, are outlined. Ha(10)

On the Various Methods to Favor Graphitization in White Cast Iron. H. Sawamura. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 34; *Mining & Metallurgy*, Part 2, pages 307–357.
A favorable effect on graphitization, ranging from strong with Si to weak with P, was found with Si, Al, Ti, Ni, Cu, Co, P and an unfavorable one, ranging from weak with W and Mo to strong with Cr and S, was found with W, Mo, Mn, V, Cr, S. Au and Pt also favor graphitization. The effect of various gaseous atmospheres and different packing materials was studied. Chill cast metal is more readily graphitized than sand cast. Water quenching of white iron from 850° C. cuts the time required for graphitization down to about ¼ that required by unquenched material. Repeated quenching was tried on some samples; so the forms of the specimens must have been such that they did not crack on quenching. The article is too diffuse for adequate abstracting. HWG(10)

18-8, Correct Heat Treatment Essential. Charles A. Scharschu. *Metal Progress*, Vol. 20, Aug. 1931, pages 68–74, 106.
The decomposition of austenite in this alloy at temperatures 800–1500° F. with accompanying loss of corrosion resistant properties is discussed. Effect of hot and cold work followed by long draws at various temperatures, on the physical properties is shown graphically. The effect of cold work on the decomposition of the austenite is shown in tabulated magnetic properties. Annealing temperatures of 1900–2000° F. are recommended for most economical annealing, best fatigue and corrosion resistance. Effect of small amount of other alloys such as silicon, tungsten and molybdenum are briefly discussed. WLC(10)

Hardening (10a)

Steels Hardened Magnetically to 1000 Brinell. C. H. Desch, Sheffield, England. *Metal Progress*, Vol. 20, Sept. 1931, pages 87–88.
The writer describes combination heat treatment hardening, "cloudburst" work hardening and a magnetic treatment resulting in extraordinary high hardness in a high speed and C tool steel of over 1000 Brinell. WLC(10a)

Magnetic Hardening of Metals. Edw. G. Herbert. *American Machinist*, Vol. 74, June 25, 1931, pages 967–971.
A newly discovered method of superhardening steel is the cloudburst process in which hard steel balls, generally 3 mm. or ⅛ in. in diameter are caused to fall from a height of 4 m. at a rate of about half a million/min. and bombard hard steel articles placed in the shower. The result of this process is a great increase in hardness. The reason for this phenomenon was seen in a rearrangement of the atoms under the bombardment. The author tried to bring about a similar hardening effect by rearranging the steel atoms under the influence of magnetic fields. Even materials regarded as non-magnetic such as Al, brass, etc. responded to this treatment and became harder. The hardness obtained by the cloudburst process is, however, greater. The tests are described and curves are reproduced. Ha(10a)

Cyaniding and Salt Bath Working. J. W. Urquhart. *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 989–993.
General discussion of salt baths for heating or hardening; temperature ranges of various salts and salt mixtures, preparation and freeing of grease of materials to be treated. Case hardening cyanides and their application are described. Ha(10a)

The Effect of Temperature of Quenching Medium on the Hardening of Steel. M. Mikami. *Kinzoku no Kenkyu*, Japan, July 1931, pages 398–402.
The present writer investigated the effect of temperature of quenching medium on the hardening of steel of 0.59, 0.89 and 1.28% of C. The size of specimen was 25 mm. in diameter. In the temperature range 0–50° C. of quenching water, the hardening decreases very slowly, but from 50 to 60° C. very rapidly. This critical range depends of course upon the size of the specimen. As for refined rape-oil, the hardness increases in the range 40–50° C., because of the diminution of viscosity of the oil, and then slightly diminishes up to 150° C.; if the quenching is not severe, a small minimum is observed in the vicinity of 70° C. This abnormal change has been explained as the combined effect of viscosity and of vaporization. KT(10a)

Annealing (10b)

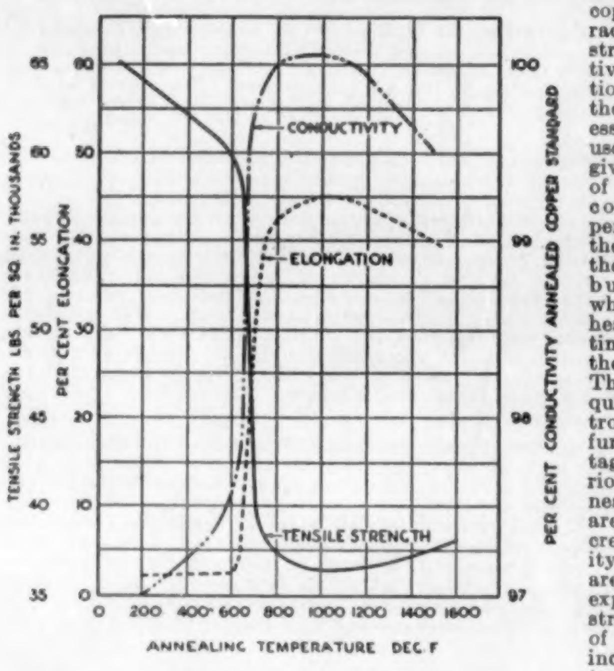
The Method of Continuous Annealing and the Fundamentals of Heat Transfer in the Continuous Oven. (Das Durchzieh-Glühverfahren und die Grundlagen der Wärmeübertragung in Durchziehöfen.) O. Junker. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 158–160.
Chiefly mathematically descriptive of temperature and heat transfer conditions. Continuous belt annealing permits uniform heating. The velocity of the heating and the heat itself may be regulated at will, as well as heating and cooling ranges. These new features of gradation in heat-treatment permit the production of superior material with respect to deep-drawing and grain size. Upon the basis of the Newton law of cooling, an equation is developed for the course of the belt temperature. The mean heat transfer number, α, is determined for a charge of brass strip from experimental values by the use of the equation developed. This number is made up of 3 components: the heat conductivity of the separating air layers, convection in these layers and radiation exchange. The last component is the chief one, accounting for 91.5%. RFM(10b)

Bright Annealing and Other Operation in Controlled Atmospheres. J. F. Schrumm (Process Engrg. and Equipment Corp.). *Metal Progress*, Vol. 20, Oct. 1931, pages 77–80, 100.
Batch and continuous type furnaces for annealing non-ferrous metals in controlled atmospheres to prevent discoloration are described. WLC(10b)

The Reduction of Natural Tensions by Annealing. (Die Verminderung von Eigenspannungen durch Anlassen.) R. Mailänder. *Krupp'sche Monatshefte*, Vol. 12, June 1931, page 139–147.

Natural tensions are the results of elastic deformation which may be due to any mechanical or thermal cause. Their magnitude is dependent on the existing elastic deformations and the elasticity modulus of the material. The theoretical relations of these existing deformations and those produced by heating are treated and investigated for means of reducing the inner tensions by heating. The method of annealing is described and a tension diagram is given showing the relation of tension to total elongation. Test results for a chrome-nickel steel are reproduced in curves and diagrams. It is shown that this method permits the determination numerically of the magnitude of the tension remaining after annealing. The results are valid only for a state of tension in one axis and cannot be applied directly to large pieces of material where transverse tensions also take place. 9 references supplement the paper. Ha(10b)

The Bright Annealing of Copper and Its Alloys. O. S. Haskell. *Electrical Manufacturing*, Vol. 8, Sept. 1931, pages 39–40.



EFFECT OF ANNEALING ON THE PROPERTIES OF COPPER AT ROOM TEMPERATURE (BARDWELL)

Annealing of copper wire changes radically the tensile strength, conductivity and elongation. Accordingly, the annealing process varies with the use the wire is to be given. The effect of annealing on copper wire depends not only on the length of time the heat is applied, but the rate at which the wire is heated. Annealing time varies with the size of the wire. These factors require accurate control of annealing furnaces. Advantages of the various types of annealing furnaces are discussed. Increased conductivity and elongation are gained at the expense of tensile strength, and all 3 of these vary with increasing temperature. Notice that there is a point beyond which increased temperature results in decreased conductivity and elongation, and increased tensile strength. WAT(10b)

Case Hardening & Nitrogen Hardening (10c)

Modern Case-Hardening Practice. Francis W. Rowe. *Heat Treating & Forging*, Vol. 17, Apr. 1931, pages 372–373; May 1931, pages 475–479; July 1931, pages 721–722, 725.

A review of steels used for case hardening and their compositions, furnaces for case hardening, carburizing compounds, heat treatment after carburizing, quenching media and nitrogen hardening. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 220. (10c)

Nitriding Analyses—Their Physical Properties and Adaptability. R. S. Sergeson & M. M. Clark. *Machine Shop Practice (A.S.M.E. Trans.)*, Vol. 53, Jan.-Apr. 1931, pages 9–16.

A great number of microphotographs, curves and illustrations show the field of application for nitrided parts, their structure and physical analysis. The influence of heat treatment is also shown in test results. Ha(10c)

Thermo-Diffusion of Elements in Steel. John H. Hruska. *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1397–1401, Dec. 1930, pages 1530–1533; Vol. 17, Jan. 1931, pages 35–39.

The treating of steel by heating in an atmosphere or surrounding it by other materials is fully discussed. 2 diagrams are given which show clearly in which way the diffusion of non-metallic and metallic elements goes and the manner in which it is carried out. The diffusion of specific elements into iron and steel can be represented by the equation $X = \dfrac{E}{\left(\frac{E}{e}-1\right)\left(\frac{d}{D}\right)^n+1}$ where X is the percentage of the diffusing element on the surface, e the percentage of the diffusing element in the core, d the distance from the surface corresponding to X and D the total depth of penetration or case. The exponent n must be obtained from at least 3 experimentally determined points of the curve and then assumes the value $n = \dfrac{\log (E-x)e - \log (E-e)X}{\log d - \log D}$, where x means the third point of the curve. The thermo-diffusion of C, O, N, Al, Cr, V and Si are treated in detail. Temperatures of the diffusion, time of the process diffusion, concentration and testing are described and curves illustrating the results are given. Ha(10c)

Carburizing with Various Gases. E. C. Cook. *Fuels & Furnaces*, Vol. 8, Dec. 1930, pages 1667–1668.

The various gases used for this purpose are enumerated and their particular properties are briefly described. Ha(10c)

Short Time Nitriding. John J. Egan (Union Carbide and Carbon Research Lab.). *American Society for Steel Treating, Preprint* No. 19, 1931, 16 pages; *Fuels & Furnaces*, Vol. 9, Oct. 1931, pages 1165–1166.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The author describes several methods of shortening the time of nitriding. The duplex cyanide treatment; use of ammonia and nitric oxide, ammonia with nitrogenous compounds and activated sand as a packing material; the use of the electric spark in the nitriding chamber and ultra violet radiation on the specimen are discussed. Results of a wear test on resulting nitrided cases are reported. Ha+WLC(10c)

The Role of Energizers in Carburizing Compounds. George M. Enos (University of Cincinnati). *American Society for Steel Treating, Preprint* No. 36, 1931, 23 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. A study of various energizing materials is presented showing that carbonates are not essential. It is shown that O must be present either as air or in an oxide that will readily yield O to form oxides of C. Some materials are shown to have a negative energizing effect. WLC(10c)

Cyanide Heat for Alloy Steel. D. A. Holt (Roessler & Hasslacher Chemical Co.). *Metal Progress*, Vol. 20, Oct. 1931, pages 68–72.

The utility of cyanide for the case hardening of certain high grade materials is discussed. Control of depth and quality of case is discussed in reference to a number of special steels such as SAE 2345, 3135, 3335, 4140, 5150 and 6150. WLC(10c)

The Action of Molecular Nitrogen on Iron-Carbon Alloys. H. H. Gray & M. B. Thompson. *Journal Society Chemical Industry*, Vol. 50, Sept. 18, 1931, pages 353–357T.

A 0.37% C steel (polished) was heated for 5 hrs. in highly purified N at temperatures from 100° to 1100° C., cooled to room temperature in N and examined under the microscope. The outstanding features were as follows: Up to 550° C., the chief effect of the N is to react with the available Fe and form iron nitride (at the same time, pearlite is attacked). At 600° C., the reaction product and the structure change. Between 700° and 800° C., the destruction of the pearlite, which practically completes itself at 800° C., gives rise to new and definite structures. At 850° C., the transparent layer makes its appearance. Analysis indicates that this layer contains N. From 850° to 1100° C., the formation of the transparent layer takes place with increasing ease. Its formation coincides with a falling off in the C removal. The transparent layer shows signs of developing crystals from a supercooled fused mass and there is a certain amount of evidence that the amount of secondary crystallization can readily be influenced by the rate of cooling. Other effects were obtained which can probably be explained by the observations of Fry and Schottky (*Stahl und Eisen*, Vol. 43, 1923) that Fe and N form several nitrides and that the action of ammonia on Fe-C alloy results in the formation of several complicated Fe-C-N compounds, the composition of which is unknown. An 0.84% C steel was nitrogenated at 750° and 1100° C. In neither case was there satisfactory evidence of the formation of the transparent layer. No lamellar pearlite was found. At 1100° C., the surface contained many small prisms. The chief conclusion drawn from these 2 nitrogenations was that C is first attacked by the N and the transparent layer is not formed. A zone of maximum decarburization was shown to exist between 700° and 800° C. The photomicrograph at 800° C. indicates complete decarburization. VVK(10c)

Nitriding in Industry. J. Muller. *S. A. E. Journal*, Vol. 29, Sept. 1931, pages 236–240.

Steel for nitriding must be held to close limits in the essential elements such as Cr, Mo, and Al and the material should be heat treated and drawn to limits that are relatively hard for machining to provide a core of sufficient strength to support the case. The temperature of nitriding affects both the surface hardness and the hardness gradient within the case, the maximum hardness being in inverse ratio to the temperature of the reaction. The effects in hardness both at the surface and at various depths in the case under different conditions are represented by graphs. Active circulation of the ammonia in the furnace promotes uniformity of the product. A furnace design to give reversing circulation is described and illustrated. The material selected for the lining of the furnace must be such as not to interfere with the reaction between the ammonia and the material under treatment. The advantages of a new duplex method of treatment, in which the work is done at 2 different temperatures, are mentioned. Questions in the discussion led to the statement that new types of steel suitable for nitriding are under development but only one type is now recognized as suitable. Experiences were given in regard to distortion or growth of the metal during nitriding. References were made to continuous and other types of nitriding furnaces suitable for large production. WAT(10c)

Recent Applications of Nitrided Steels. (Recenti applicazioni dell acciaio nitrurato.) A. Quagliotto. *La Metallurgia Italiana*, Vol. 23, Sept. 1931, pages 824–832, 13 figures.

Examples of wear resistance of cams, gears, cylinders, brick dies, etc., etc. in actual service are cited, the life being compared with that of the material which it replaced. The examples chosen show a huge increase in life. HWG(10c)

Case Hardening. A Survey of the Results of Recent Investigations. (Die Einsatzhärtung. Eine Zusammenfassung neuer Forschungsergebnisse.) H. Müller. *Archiv für Eisenhüttenwesen*, Vol. 5, July 1931, pages 57–62.

The paper deals, first, with the conditions which cause a normal or abnormal structure in steel. The media of case carburizing and nitriding are then considered. CO causes a gradual transition of the zones of various C contents, a slow carburizing and a small C content of the edge. CO under pressure speeds up the carburization. Pressure does not accelerate the carburization with hydrocarbons. Hydrocarbons show no gradual transition of the carburized zones. This can be improved by increasing the temperature of carburization. The most favorable carburizing temperature is between 850° and 900° C. In order to avoid the formation of a cementite network, the cooling velocity after carburization should be as rapid as possible. GN(10c)

High Frequency Oscillations. Influence on Metals and Alloys. M. G. Mahoux. *Iron & Steel Industry & British Foundryman*, Vol. 4, June 1931, pages 290, 312.

Under the influence of high frequency oscillations, a Cr-Ni-Mo steel held for 9 hrs. at 500° C. and in a current of ammonia gas had a Vickers hardness of 1033 at the surface with a penetration of nitriding of 0.35 mm. The same material under identical conditions but without the high frequency oscillations gave no measurable hardness increase. With the same treatment, an austenitic valve steel had a surface hardness of 1035 with no variation in hardness without oscillations. The Cr plating on a mild steel penetrated to a depth of 0.35 mm. after 9 hrs. at 530° C. under the influence of high frequency oscillations. The plating was unaffected without oscillations. For the same conditions, a cast iron was covered with C deposition and decarburized superficially to a depth of 0.8 mm. CHL(10c)

Quenching (10d)

Identification of Quenched Duralumin. L. Pessel. *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1417–1418.

A method is given by which spots appearing on tests make it possible to determine whether a piece has been hot or cold quenched. Photographs illustrate the difference. Ha(10d)

Progress in the Quenching of Steel. J. W. Urquhart. *Heat Treating & Forging*, Vol. 17, July 1931, pages 672–674.

For the production of the hardest steel surfaces, a certain critical speed of heat abstraction from the piece to be quenched must be provided. The utility of various cooling media are treated in detail: the descaling action of soda coolants which take off any adherent film of oxide rapidly and so expose the true steel surface to the quenching medium, the special combination coolant for steel stripping where the question of penetration does not enter (on account of the thinness), and the quenching of heavy masses. For heavy masses, a method of combined quenching and tempering is being used extensively. It consists of immersing the steel in the coolant until the surface appears black. This method, while quite safe, does, however, not develop the full tensile property of the steel throughout the mass. Ha(10d)

Quenching (10d)

Aqueous Solutions of Ethylene Glycol, Glycerine and Sodium Silicate as Quenching Media for Steel. Thomas E. Hamill. *Bureau of Standards, Journal of Research*, Vol. 7, Sept. 1931, pages 555–571 (Research Paper, Bureau of Standards No. 357.)

The quenching characteristics of aqueous solutions of ethylene glycol, glycerine and sodium silicate were studied by means of temperature-time cooling curves on small cylinders of a 0.96% C steel quenched in solutions of various concentrations and temperatures. Center cooling curves are given for cylinders one-half inch in diameter by 2 inches long, quenched in aqueous solutions of ethylene glycol and glycerine at atmospheric temperature. Surface and center cooling curves are given for aqueous solutions of 2 lots of sodium silicate having different soda-to-silica ratios, namely, 1:4 and 1:2.5. These 2 silicates are designated in this report by the ratios. Tne effect of increasing the temperature of solutions of the 1:4 sodium silicate from 20° to 80° C. was studied. The characteristics of these cooling curves and a study of the hardnesses and structures produced suggest that these sodium silicate solutions would be useful for obtaining cooling rates from slightly less than that obtained with water to that of oil. 4 concentrations of the 1:4 sodium silicate having specific gravities corresponding to 4.6°, 9.5°, 13.2° and 16.7° B and 2 of the 1:2.5 sodium silicate, 12.4° and 28.8° B, were found which gavei ntermediate cooling rates between those obtained with water and with oil at atmospheric temperature. Some trouble was experienced with the instability of certain of the aqueous solutions of the 1:4 sodium silicate. The stability of these solutions was greatly increased by the addition of 2% by volume of a solution of sodium hydroxide of specific gravity 1.065. The wide variations in cooling produced by check tests on aqueous solutions of ethylene glycol and of glycerine indicate that these solutions may not be particularly useful as media for the quenching of steels. Quenching experiments with "stepped" bars of a 1.06% C steel indicate that sodium silicate solutions can be used at atmospheric temperature to provide coolants with graded cooling speeds between those of water and oil. WAT(10d)

The Mechanism of Quenching High-Carbon Steel Tools. P. J. Haler. *Fuels & Furnaces*, Vol. 8, Dec. 1930, pages 1653–1659.

The scientific principles involved in hardening and quenching are explained by the 4 allotropic forms of pure Fe. The quenching of the various types of high C or case-hardened steels, the mechanism of cooling and the effect of heat on the stream lines around the piece being quenched are discussed. Ha(10d)

Drawing (10e)

Tempering of Special Steels Quenched from High Temperatures. (**Étude sur les revenus d'aciers spéciaux hypertrempés.**) A. Michel & P. Benazet. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 327–333.

Discussion of high C, medium and high Cr, CrW, CrCo and CrCoW, air quenched from 1150° or 1250° C. 11 dilatometer curves are given to show the decomposition of the austenite retained on quenching. HWG(10e)

Three Overlapping Reactions Occur during Tempering. Correspondence from A. Portevin, Paris, France. *Metal Progress*, Vol. 20, Sept. 1931, pages 89, 114.

The writer presents briefly the results of an extensive study of tempering reactions involving the study of several physical properties or characteristics of the several phases resulting in tempering. WLC(10e)

Aging (10f)

The Precipitation Hardening of Iron-Phosphorus Alloys. (**Ueber die Ausscheidungshärte der Eisen-Phosphor-Legierungen.**) W. Köster. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 609–611; *Stahl und Eisen*, Vol. 51, June 25, 1931, page 797.

The author investigated the hardenability of an alloy with 1.5% P and 0.06% C by quenching from 1000° C. and tempering in 1/2 hr. steps up to 800° C. The hardness increases between 450° and 700° C. with a maximum between 550° and 600° C. In a similar manner, the electric conductivity and the magnetic properties were studied. The conductivity increases up to 725° C. and then decreases. The solubility of P in α-Fe obviously increases above 725°. In measuring the magnetic properties, the alloy shows a behavior which is in conformity with the known experience with the decomposition of supersaturated solid solutions. The small increase of magnetism between 200° and 350° C. points to a segregation of cementite. A rapid increase occurs between 600° and 700° C. and must be considered to be due to the decomposition of the solution supersaturated with P. The measurements are in perfect agreement with the microscopic examination. In slowly cooling, Fe_3P crystallizes in needles while the saturation of P in α-Fe decreases. In quenching above 700° C., the amount of the needles decreases and, in quenching above 1000° C., the alloy is composed only of homogeneous α-crystals. The decomposition of the above supersaturated solid solution is characterized between 650° and 700° C. by the appearance of numerous fine crystals. The increase of hardness during tempering evidently is not accompanied by a microscopically noticeable change of structure, whereas the increase of the coercive force coincides with the visible separation. In etching the tempered specimens, it was observed that spots which had been deformed previous to the tempering are more readily attacked than the non-deformed matrix. GN(10f)

Properties of Sheet Steel Change with Age. Correspondence from A. M. Cox. *Metal Progress*, Vol. 20, Sept. 1931, page 85.

The writer presents results showing an aging effect in cold rolled sheet steel involving an increase in ultimate strength and Rockwell hardness and a decrease in the elongation after 2 months' aging, further aging for 6 months is without additional effect. WLC(10f)

Aging in Low-Carbon Steels. A. Allan Bates (Case School of Applied Science). *American Society for Steel Treating, Preprint* No. 13, 1931, 23 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. 23 micrographs show the structures studied. The author shows low carbon steel to be capable of age-hardening to a 50% increase in its ultimate strength and Brinell hardness. The hardness is due to submicroscopic particles of precipitated carbide. 25–30 days are required for the completion of this effect at room temperature. Very notable hardening can be shown on aging 30 minutes at 100° C. (212° F.). Age-hardening may be avoided by slow cooling from temperatures near A_1 or by drawing for a suitable length of time to precipitate the carbide in sizes which will not cause hardening. WLC(10f)

The Influence of Cold Work on Aging Following Quenching. (**Die Beeinflussung der Vergütung durch Recken nach dem Abschrecken.**) W. Fraenkel. *Zeitschrift für Metallkunde*, Vol. 23, June 1931, 172–176.

The effect of cold work immediately following quenching on the velocity of aging of 3 typical age-hardening Al alloys was studied by measurements on Brinell hardness, tensile strength, elastic limit and electrical conductivity. The sensitivity toward working varies and is especially great with alloys containing Zn and Li. The increase of electrical resistance with aging in duralumin is smaller with the pre-worked alloy. RFM+EF(10f)

JOINING OF METALS & ALLOYS (11)

Fluxes for Welding and Brazing. A Contribution to the Chemistry of the Fluxes. (Flussmittel zum Schweissen und Hartlöten. Ein Beitrag zur Chemie der Flussmittel.) E. LUEDER. *Schmelzschweissung*, Vol. 10, Aug. 1931, pages 197–201; Sept. 1931, pages 220–222.

The action of a flux consists of a dissolving process, the physical and chemical conditions of which are given in detail. The temperature is of great importance; for the different processes, the following temperatures are required:

Aluminum brazing	550°–630° C.
Aluminum welding	660° C.
Brazing with silver fluxes	700°–850° C.
Brazing with brass fluxes	850°–950° C.
Welding of copper alloys	900°–1000° C.
Welding of copper	1100° C.
Welding of gray castings	1200°–1300° C.
Hammer welding of iron	1300°–1350° C.
Welding of nickel	above 1400° C.
Welding of non-rusting steels	above 1450° C.

The various fluxes are described. The so-called universal fluxes are noted as unsatisfactory; they usually cover only a certain range. It is much better to apply a flux suitable for the purpose in question. Ha(11)

Hard Facing in the Steel Industry. W. B. MOORE (Haynes Stellite Co.). *Metal Progress*, Vol. 19, June 1931, pages 77–80.

The author describes and discusses the application of a hard face attached by welding or brazing to surface subjected to severe conditions of wear. WLC(11)

Brazing (11a)

The Process of Increased Strength in Brazing of Gray Castings, Malleable and Steel Castings. (Das Verfahren erhöhter Festigkeit bei Grau-, Temper-, Stahlguss-Hartlötungen.) H. STREBEL. *Die Schmelzschweissung*, Vol. 9, July 1930, page 165.

The strength of a brazed joint can be greatly increased by reinforcing with a steel wire insert analogous to reinforced concrete. This wire is first soldered on to the material. Ha(11a)

Can Brazing Be Considered as Non-Objectionable Construction or Joining Method? (Kann die Hartlötung als einwandfries Konstruktions- oder Verbindungselement betrachtet werden?) FELIX WECKWERTH. *Schmelzschweissung*, Vol. 10, Aug. 1931, pages 191–195; Sept. 1931, pages 228–232.

Brazing should be done with torches which cannot heat cast iron above 950° C. In general, the flame should be neutral or adjusted to have a little excess of O. The best formation of solid solutions can be expected with slow heating, annealing of longer duration during the melting stage, and subsequent annealing at slow cooling if the structure of the cast iron and the solder is not to be injured. Using borax as a flux, the same results can be obtained as with special fluxes and solders for cast iron. Swelling fluxes must be avoided. Good fluxes which come off after cooling have the advantage that a subsequent machining of the seam is feasible. Too small seams should be avoided; the seams should have a greater width in front of the flame than on the opposite side. The greatest strength can be obtained with a shearing-soldered connection offering the greatest diffusion surface; the strength is so great that the joint can be used as construction methods for rebuilding of castings. Ha(11a)

Soldering (11b)

Soldering 18-8 Stainless. KENNETH T. MACGILL. *American Machinist*, Vol. 74, Mar. 5, 1931, page 386.

A special solder and a special flux has been developed to aid in soldering stainless alloys. Does not give composition of either solder or flux. Joints in Allegheny metal have shown 8000 lbs./in.² on tensile pull tests. RHP(11b)

Repair of a Cooling Mantle of a Tensile Testing Machine by Soft Soldering. (Ausbesserung eines Kühlmantels an einer Zugmaschine durch Weichlöten.) W. K. RAABE & M. WIENCKE. *Autogene Metallbearbeitung*, Vol. 24, July 15, 1931, page 215.

Description of the way in which the work was done. Soldering took only 17 mins., even when the piece had previously been Cu coated. Ha(11b)

Welding & Cutting (11c)

Arc Welding Joints in Steel Structures. R. W. VAN KIRK. *Iron & Steel Industry & British Foundryman*, Vol. 4, Sept. 1931, pages 407–409.

General. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 179. CHL(11c)

Ways of Proving a Good Weld. T. R. WATTS. *Electrical World*, Vol. 98, Oct. 10, 1931, pages 645–648.

Four means of proving a good weld are: (1) close watch over trained operators; (2) tack hammer and stethoscope tests; (3) γ-ray photos surpass X-ray method; (4) magnetic methods show most promise. Careful training and classification of workers is now conducted with good effect. The stethoscope discloses some flaws. The Sperry electromagnetic method is outlined. In this test, iron filings or powder are sifted onto a piece of paper placed on the weld. The picture formed indicates any possible flaws. A weld test meter is being perfected. It is claimed to be practically indifferent to the depth at which the fault is buried and under the most favorable conditions gives results from which the approximate efficiency of the joint can be determined by reference to calibration curves made on comparable test specimens. It is best employed with the electromagnetic test. WHB(11c)

The Testing of Welded Seams. (Ueber die Prüfung von Schweissnäten.) H. SCHMUCKLER. *Autogene Metallbearbeitung*, Vol. 24, Aug. 1, 1931, pages 231–234; *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 6, 1931, pages 37–41.

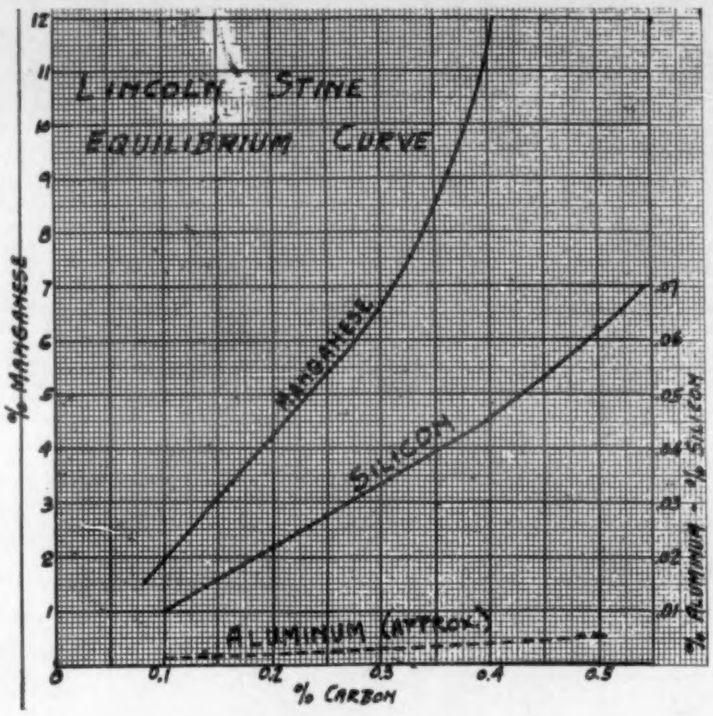
The author has developed a testing apparatus for welded seams. He claims that this apparatus gives direct insight into the quality of the weld which cannot be obtained with magnetic testing or by other simple methods. He uses a small milling tool with 45 degree head with which a direct incision into the seam is made. The spot where the incision is made is so small that the weld is not weakened. It takes about 1–2 mins.; the miller is driven by a little electric motor of 400 watts. The incision can be closed again by welding or left and painted over. Ha(11c)

Welding Progress in Railway Shops. JAMES M. VOSSLER (Southern Pacific Lines). *Welding*, Vol. 2, Sept. 1931, pages 599–601.

Experience in railway shop welding has taught the importance of preheating and postheating parts to reduce residual stresses. Careful cleaning of welds is also necessary. The author explains the procedure for various railway shop welding applications. He believes that the next 5 years will show improvements in welding electrodes and welding procedure which will result in the removal of restrictions imposed on welding by the Interstate Commerce Commission and railway officials. TEJ(11c)

Research Removed Barrier to Sound Welding. W. E. STINE. *Western Machinery World*, Vol. 22, pages 258–259, June 1931.

Research work at the Lincoln Electric Company, Cleveland, Ohio, has



led to the development of the chart. WAT(11c)

Mixture in the Acetylene-Oxygen Welding Torch. (Mischung im Azetylen-Sauerstoff-Schweissbrenner.) E. STREB. *Autogene Metallbearbeitung*, Vol. 23, Apr. 15, 1930, pages 118–126.

See *Metals & Alloys*, Vol. 2, July 1931, page 133. Ha(11c)

Influence of Acetylene Pressure on the Quality of the Welded Seam. (Einfluss der Azetylendrücke auf die Güte der Schweissnaht.) E. STREB, E. ZORN & GABLER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Aug. 29, 1931, pages 1101–1103.

Comments on a paper by Gabler. This paper warned against a generalization because the results depend, in too large a degree, on the welder. It is also noted that an increase of pressure of acetylene increases the output. The author refutes these remarks. 8 references are cited. Ha(11c)

Welding Design Errors. (Schweisstechnische Konstruktionsfehler.) DR. WEHRMANN. *Schmelzschweissung*, Vol. 10, July 1931, page 180.

Due to heat stresses, a re-enforcing ring of segments of 400 mm. length did not hold. The sub-division into pieces of 250 mm. length gave perfectly safe results after welding. Ha(11c)

Estimating of Fusion Welding and Cutting Work. (Kalkulation von autogenen Schweiss- und Schneidarbeiten.) W. K. RAABE. *Autogene Metallbearbeitung*, Vol. 24, May 15, 1931, pages 143–145.

Explains the calculation of acetylene and oxygen, their ratio and the overhead tor work of this kind. Several curves for average data as to unit prices, cutting lengths for different sheet thicknesses, etc., are given. Ha(11c)

Questions of Material in Gas Fusion-Welding. (Werkstoffragen bei der Gasschmelzschweissung.) RAPATZ. *Schmelzschweissung*, Vol. 10, Sept. 1931, page 226.

Discussion of the influence of the kind of material on the type of welding to be used and the application of fusion welding by gas. It may be adapted within a very wide range to suit the materials to be joined. Ha(11c)

Technical Welding Education in the Vocational School. (Schweisstechnische Ausbildung in der Berufsschule.) RUCK. *Autogene Metallbearbeitung*, Vol. 24, May 15, 1931, pages 145–146.

Education for welding as obtained in a vocational school is found to be better than as apprentice in industrial plants. Ha(11)

Stresses in Material Cut with Oxygen. (Materialspannungen bei Sauerstoffschnitten.) L. v. ROESSLER. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 6, 1931, pages 41–49.

Measurements were made to determine the course of the stresses in flame cutting and their dependence on the dimensions of the material. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 222. Ha(11c)

The Combined Fusion-Electric Welding Process "Arcogen." (Das kombinierte autogen-elektrischen Schweissverfahren "Arcogen.") H. MUENTER & E. WISS. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 6, 1931, pages 7–21.

See *Metals & Alloys*, Vol. 2, Oct. 1931, page 223. Ha(11c)

The Metallurgy of Fusion Welding. (Metallurgische Betrachtungen über die Schmelzschweissung.) F. RAPATZ. *Stahl und Eisen*, Vol. 51, Feb. 26, 1931, pages 245–253.

Report 168 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The suitability of filler metal for welding purposes depends upon a slow and undisturbed melting-off of the filler metal and a good combination of the deposited metal with the base metal. Welding with uncoated electrodes causes non-metallic inclusions when the electrode is the negative pole. This type of welding is most suitable for use in welding soft steel. The method cannot yet be used in welding higher C steels and alloy steels. Good melting-off of uncoated electrodes when connected to the positive pole is obtained in welding almost any type of steel; however, the penetration of the deposited metal into the base metal is not remarkable. In welding with alternating current, coated electrodes can always be used but uncoated electrodes are not suitable. In welding with direct current and with thickly coated electrodes, the electrode is always the positive pole. In gas welding, the rods should be free from larger amounts of non-metallic inclusions. The composition of the weld depends on the absorption of gases, the oxidation of the various components and the combination with the welded piece. The effect of alloys upon the properties of the weld, as well as the effect of the heat upon the structure of the parts around the weld are discussed. Larger parts of the structure of the piece are more affected in gas welding than in arc welding. In welding high alloy steels, the piece is extremely affected by air hardening. In testing welds, all processes of deformation are complicated due to the variety of the zones affected. GN(11c)

Pipe Welding in Architecture. **(Die Rohrschweissung in der Architektur.)** H. Juergens. *Autogene Metallbearbeitung*, Vol. 24, Oct. 15, 1931, pages 305–307.

A few examples of applications in banisters, railings, stairs, etc., are illustrated. Ha(11c)

Arc Welding Joints in Steel Structures. R. W. Van Kirk. *Western Machinery World*, Vol. 22, Sept. 1931, pages 405–406.

Recommended current values and sizes of bare and lightly coated electrodes for various sizes of welds are given. The advantages of arc welding are pointed out and the necessity of careful inspection is emphasized. WAT(11c)

Fabrication of Copper Products by Welding. S. J. Mashl. *Metal Stampings*, Vol. 3, July 1930, pages 643–644.

Abstract or paper read before the Chicago Section of the American Welding Society. See "Copper Welding in the Chemical Industry." *Metals & Alloys*, Vol. 2, Mar. 1931, page 70, MS(11c)

Welded Tube Construction. G. H. Handasyde. *Aircraft Engineering*, Vol. 3, Oct. 1931, pages 249–250.

The methods employed in the manufacture of welded tube members for air craft construction of the A. V. Roe & Co., of Manchester, England, are briefly described and shown. WAT(11c)

Welding. A. B. Arganbright (Wheeling Steel Co.). *Iron & Steel Engineer*, Vol. 8, Aug. 1931, pages 360–361.

A brief discussion of all types of welding, gas, arc, atomic hydrogen, resistance and thermit. The manufacture and inspection of welding wire are taken up. WHK(11c)

Gas-Welded Pipe Structures. **(Gasgeschweisste Rohrbauten.)** Otto Bondy. *Schmelzschweissung*, Vol. 10, Oct. 1931, pages 243–245.

A few examples of special structures and details of their construction. Ha(11c)

The Helical Precision Autogenous Welding Process in the Manufacture of Welded Metal Hose. **(Die Schraubenförmige Präzisions-Autogenschweisserei bei der Fabrikation von geschweissten Metallschläuchen.)** W. Greiner. *Autogene Metallbearbeitung*, Vol. 24, Oct. 15, pages 303–305.

The paper gives a detailed description of the manufacture of metal hose for pressures of several hundred atmospheres which are entirely tight and safe. The equipment is described; hose of from 6-2000 mm. inner width can be made; the thickness of the metal ribbon varies from 0.5 to 2.5 mm Ha(11c)

The Construction of Autogenously Welded Structures of Profile Irons. **(Die Ausbildung von autogen geschweissten Säulen aus Profileisen.)** E. Greger. *Die Schmelzschweissung*, Vol. 10, Oct. 1931, pages 246–247.

The most advantageous procedure for building up a column is demonstrated by means of an example. Ha(11c)

Autogenously Welded Connections of Electric Conductors. **(Autogen geschweisste Verbindungen elektrischer Leitungen.)** L. Gavanda. *Autogenschweisser*, Vol. 4, No. 3, 1931, pages 41–42.

The making of perfect contacts between electric conductors by welding instead of by terminal clamps is recommended, especially for heavy conductors, bus bars, etc. The ends to be welded are best heated in a charcoal fire to red heat before the actual welding with the oxy-acetylene flame is done. The cost for welding 2 bus bars of 10 × 100 mm. is given as about 10 Rm. Ha(11c)

Advantageous Practical Application of Acetylene Welding and Its Saving Compared with Older Joining Methods. **(Vorteilhafte praktische Anwendung der Azetylenschweissung und ihre Ersparniss gegenüber den älteren Verbindungsmethoden.)** H. Holler. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen*, Series 6, 1931, pages 21–27; *Autogene Metallbearbeitung*, Vol. 24, Aug. 1, 1931, pages 223–230.

Describes and illustrates some difficult and complicated welds of evaporators, large boilers, branches of large pipes, radiators, etc. Ha(11c)

Automatic Gas Cutting—Central Control and Multiple Torch Operation. R. E. Helmkamp. *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 36–38.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Advantages of multiple torch machine cutting are increased production in same elapsed time, with no increase in labor cost and floor space required. TEJ(11c)

Looking Ahead in the Welding Industry. W. D. Flannery. *Welding*, Vol. 2, Sept. 1931, pages 595–596.

It is forecast that the future dwelling house will be of welded steel construction. The various transportation systems offer great possibilities for the advancement of welding. TEJ(11c)

Welded Instead of Cast. **(Geschweisst statt gegossen.)** H. Holler. *Die Schmelzschweissung*, Vol. 10, June 1931, pages 142–147.

Several examples of auxiliary tools, jigs, sprocket wheels, holding devices for lathes, etc., are illustrated, showing the many advantages of fusion welding over the casting of such devices. Ha(11c)

All Ships Will Be of Welded Construction. Eric E. Ewertz. *Welding*, Vol. 2, Sept. 1931, pages 609–610.

Lack of trained designers, supervisors and welders has, in the past, retarded welded ship construction. Most shipyards are now equipped for welding. Within 5 years, all ships for all purposes will be the all-welded form of construction. A list of all-welded vessels built during the past 5 years, is included. TEJ(11c)

Welding of Brass and Copper Piping. DeW. Endicott. *Journal American Welding Society*, Vol. 10, July 1931, pages 26–29.

Laboratory investigations indicate that Cu, red brass, alpha brass and Munts metal pipe and tubing can best be welded by using the short-bell type of joint and high strength bronze welding rod. Brass and Cu piping and tubing are being used in constantly increasing amounts where a permanently trouble-free water supply system is desirable. Specifications covering the oxy-acetylene welding of steam and hot water brass piping are given. TEJ(11c)

Riveting (11d)

Riveting of Veneered Light-Metal Sheets. **(Ueber die Nietung von fournierten Leichtmetallblechen.)** F. Thomas & A. Westlinning. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June 1931, pages 173–181.

Great sums are wasted every year in the transport of dead masses. For instance, in transporting a person weighing 75 kg. by railroad, the weight of the vehicle is about 500 kg., by street car, 150 kg., by motor coach, 200 kg. or by four passenger automobile, 250 kg. To bring about improvement, experiments have led to the use of light metals for chassis and body. Satisfaction has resulted in both economy and safety. Sweating within the vehicle, however, resulted from the ready heat conductivity of these metals. This condition was prevented by laying wooden veneers on the metal sheets either on one side or on both sides. The method of riveting these sheets together is illustrated and test method and results are described. Ha(11d)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Desulphurization of Iron and Steel by Acid and Basic Slags. (La désulfuration de la fonte et de l'acier au moyen de laitiers acides et basiques.) A. Possenti. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 815–818.

The chemical reactions involved in desulphurising are discussed and the heats of formation of oxides and sulphides listed. The use of Italian lavas rich in leucite, and containing 9 to 11% K_2O is advocated. By magnetic concentration these can be brought up to 16 or 18%. Tests were made on 1 kg. crucible melts of cast iron previously made up with Fe S, and containing only about 0.1% Mn to avoid desulphurization by Mn. The Mn remained constant, and a slight pick-up of Si was shown. Starting with 1 kg. of iron containing 0.18% P, 0.80% S; 333 gr. leucite of 9% K_2O and 100 gr. CaO, the slag contained 1.25% S and the iron dropped to 0.10% P, 0.965% S. Another test on 1 kg. of iron with 1.42% P, 1.10% S; 250 gr. concentrated leucite of 17.5% K_2O and 50 gr. CaO, the slag contained 1.85% S and the iron fell to 0.75% P, 0.062% S. The S is said to be in the slag as K_2S, and to be thus made soluble so that the slag would be useful as fertilizer or the K_2S could be extracted with water. (No comment nor explanation is given as to the loss in P. The total weight of slag formed, which might have been greater than the weight of flux used through attack on the refractory crucible, is not given, but the total S charged is not accounted for if the slag weight is the same as that of the flux charged. The slag was not analyzed for P.) HWG(12a)

On the Steel Production in Coreless Induction Furnaces of Large Size. (Ueber die Stahlerzeugung im Kernlosen Induktionsofen grösserer Bauart.) F. Pölzguter. *Stahl und Eisen*, Vol. 51, Apr. 23, 1931, pages 513–520.

Report 207 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The paper describes 2 coreless induction furnaces of 500 kg. and 1000 kg. capacity, respectively, installed at the Bochum Research Institute of the Vereinigte Stahlwerke. The production in tons/hr., the average power consumption and the oxidation losses are compared with those of arc furnaces. In comparing the heat balances of a 7 ton arc furnace and the one ton induction furnace, the fundamental difference of current losses is described. Points of improvement of the efficiency of induction furnaces are noted. Information is given as to the metallurgy of induction furnaces and the quality of steels made. GN(12a)

The Production of High Grade Cast Iron. (Die Herstellung von hochwertigem Gusseisen.) Richard Moldenke. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 17, 1931, pages 573–576.

According to American standards, high grade cast iron is defined as having at least 35 kg./mm.^{2} tensile strength; but nowadays higher values, especially for the alloys with Ni and Cr, are quite common: The different methods of producing such material in crucible, cupola, flame and electric furnaces are discussed. Directions are given for mixing, addition of scrap and analyzing. The particular advantages of the cupola furnace especially in the form of duplex furnace, are pointed out. To obtain a strictly first-rate material, however, the electric furnace is recommended despite its higher cost for investment and operation. Ha(12a)

Purchase of Raw Materials for the Open-Hearth. (L'achat des matières premières pour fours Martin.) F. Le Personne & L. Marbais. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 117–134.

Deals with calculation of the charge and the use of scrap. HWG(12a)

The Melting Shop of the Appleby Iron Company, Limited. Arthur Robinson. *Iron & Steel Industry & British Foundryman*, Vol. 4, May 1931, pages 261–263; June 1931, pages 309–312; *Journal Iron & Steel Institute, Advance Copy* No. 15, 1931, 22 pages.

A description of the plant, equipment and steel-making and casting practices are given in detail. JLG+CHL(12a)

Motions of the Bath so Far Unobserved in Induction Furnaces. (Bisher unbekannte Badgewegungen bei Induktionsöfen.) E. Fr. Russ. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 20, 1931, pages 165–166.

See "The Electrodynamic Motions in Induction Furnaces," *Metals & Alloys*, Vol. 2, Apr. 1931, page 83. Ha(12a)

Hot Metal Open Hearth without Use of Scrap. (Procédé Martin à charge liquide sans addition de ferrailles.) S. Surzycki. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 149–150.

Two furnaces are used, one being charged with hot metal only to $^2/_3$ its capacity. When the other furnace is tapped, $^1/_3$ of its finished charge is run into the other furnace from the ladle in lieu of scrap. HWG(12a)

The Melting of Dense Bronzes for High Pressures. Defects and Their Consequences. (Das Erschmelzen von dichter Bronze für Hochdruckbeanspruchung. Fehler und deren Folgen.) M. Schied. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 24, 1931, pages 603–604.

For pressures of more than 100 atmospheres, only one alloy can be used, as for instance of the following composition: 83% Cu, 6.5 Sn, 8.5% Zn, 1% Ni with an addition of 1% of the charge of phosphorus copper. This alloy has an especially dense and uniform texture. All constituent metals should be as pure as possible. The influence of gases is discussed; it is usually harmful. The liquid metal should be properly deoxidized and the melting time should be as short as possible. Some practical instructions regarding the melting process are given. Ha(12a)

Melting Tool Steel in the Basic Electric Furnace. J. P. Gill & M. R. Trembour (Vanadium Alloys Steel Co.). *Metal Progress*, Vol. 20, Oct. 1931, pages 73–76.

The operation and advantages of the basic electric melting process are discussed. Manipulation of slags, handling of certain alloying elements, spoon ladle tests for temperature, deoxidation and pouring are discussed. WLC(12a)

Thermal Balances and Fuel Costs of Malleable Melting Furnaces. J. H. Hruska. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, June 1931, pages 20–36.

A report of systematic studies of metallurgical heat balances of melting furnaces together with actual fuel costs. An appendix of thermal data for each type of furnace is given. See also *Metals & Alloys*, Vol. 2, July 1931, page 134. CHL(12a)

Melting Nickel-Chromium Alloys in Hydrogen. C. J. Smithells, S. V. Williams & E. J. Grimwood (General Electric Co., Ltd.). *Institute of Metals, Advance Copy* No. 582, Sept. 1931, 12 pages.

Equipment for melting the alloys in an induction furnace in H is described. The alloys can be allowed to cool in H or the H can be replaced by N and the alloys poured. If all of the oxides are removed by H, the alloy solidifies without the formation of blow-holes. Various grades of raw materials were used, and it was found that alloys made from the less pure materials had a longer life at high temperature. Life tests also confirmed the superiority of the alloy containing 70% Ni, 20% Cr and 10% Mo. The addition of 1% Si to this alloy increased its life at high temperature. Ductile Ni and Ni-Cu alloys have been produced by H melting without the use of other deoxidizers. 6 references. JLG(12a)

Casting & Solidification (12b)

Piston Rings Cast by Centrifugal Process Have Close Grain and High Modulus of Elasticity. William A. Oubridge (British Piston Ring Co., Ltd.). *Automotive Industries*, Vol. 64, Mar. 1931, pages 516–517.

Castings made by the centrifugal casting machines for producing piston rings, cylinder liners, valve seats and brake drum liners for automotive uses. Molten metal placed in a container, which is revolved at high speed; the liquid metal is thus projected in an outer direction toward the interior surface of the mold. The result is a tubular casting, the exterior of which conforms to the shape of the mold. A small machine can turn out 20 to 25 castings for 3 in. rings/hr. or 1200 for a 48-hr. wk. Illustrates larger machines for producing castings from 6 in. to 14 in. and 14 in. to 30 in. diameter. Metal, 60% pig iron and 40% centrifugal or other scrap, taken from an ordinary type foundry cupola. Castings are easily machinable with high grade high-speed steel at 45 to 50 ft./min. British vehicles have almost all changed to centrifugally cast cylinder liners of either cast iron or nickel chrome. Photomicrographs of centrifugally and sand cast iron show close comparison. DTR(12b)

Chilled Casting and Pseudo-Chilled Casting. (Hartguss und Pseudohartguss.) Hugo Patsch. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 13, 1931, pages 225–227.

A definition of the meaning of chilled casting is given and the differences between white and gray iron are explained. It is stated that the quality depends not only on the mixing of the constituents and pouring temperature, but the temperature during melting in the furnace and the duration of melting are of extreme importance for the quality. The hardness of the iron is determined not only by contents of Si or P or Mn and S, but by the operation of the furnace as a whole. Ha(12b)

Casting Aluminum and Copper Alloys by the Permanent Mold Method. Jos. Pignone. *Modern Machine Shop*, Vol. 4, Sept. 1931, pages 20–24, 26.

For quantity production with good appearance, die casting has now gained a foremost position. For alloys with a melting point above 1500° F., the permanent mold method is most often applied. No pressure on the metal is used; the metal is simply poured by gravity so that the cast steel mold is exposed to high temperatures only at atmospheric pressure and deterioration is reduced to a minimum. The arrangement of molds, furnaces for melting material and their construction are discussed. The induction furnace is the most economical if electric power can be bought at 1.5c/kwhr. and if the production amounts to at least 2000 lbs./hr. The alloy most commonly used contains 92% Al and 8% Cu; it develops a tensile strength of 18,000–20,000 lbs., a yield point of about 16,000 lbs. and an elongation of 2–3%. With additions of Ni and Mg, however, other alloys with still better characteristics can be produced. Ha(12b)

Castings for Bronze Gears. Francis W. Rowe. *Metallurgia*, Vol. 3, Apr. 1931, pages 215–218; May 1931, pages 27–28; June 1931, pages 61–62.

A discussion of methods for producing heavy duty bronze gears. The density of gears forms an index of their suitability. The use of chills in casting is discussed. Excellent gears can be made by centrifugal casting. Due to the rapid cooling the constituents in bronze castings are not represented by the equilibrium diagram. The inhomogeneity produced is advantageous. The variation in properties with Cu-Sn ratio is discussed. P hardens the alloys, and in effect can be used to replace some of the Sn, but the alloys are embrittled by a high P content. The effects of Pb, Zn and Ni are also discussed. JLG(12b)

Solidification Experiments on Metal Alloys Using Pressure up to 20,000 Atmospheres. (Kristallisationsversuche an Metallegierungen bei Drücken bis zu 20,000 at.) G. Welter. *Metallbörse*, Vol. 20, Nov. 22, 1930, page 2588.

It was found that, by applying pressure to molten alloys during their solidification, the properties of the alloys could be changed. The improved quality of materials solidified under pressure is evident when comparing the fracture and the microstructure of these alloys to normal chill castings. In the case of the Al-Si alloy, the eutectic composition is changed. The eutectic is normally around 12% but if pressure is applied during solidification, the eutectic composition is between 17% and 18%. See also *Metals & Alloys*, Vol. 2, Dec. 1931, page 297. WHB(12b)

The Calculation of Occurrences in Cooling and Freezing of Liquid Metal. Part I. (Die rechnerische Behandlung der Abkühlungs- und Erstarrungsvorgänge bei flüssigem Metall. I.) C. Schwarz. *Archiv für Eisenhüttenwesen*, Vol. 5, Sept. 1931, pages 139–148.

In order to get an insight into the cooling and freezing conditions of liquid metals, the author starts with calculative considerations which consider the freezing at the beginning of the cooling process as the problem of the contact of 2 bodies, the extensions of which are very large in the direction vertical to the faces of contact. These calculations are, then, used to elucidate the conditions of the freezing of ingots in ingot molds and of the cooling of steel and pig iron in ladles. The effect of superheating, melting temperature, temperature of the mold and mold material upon the velocity of freezing and the temperature distribution of the ingot before stripping were studied. Relations are established between mold temperature and contact temperature (mold wall-steel) for various superheating temperatures. Similar relations are established between ladle wall temperature and minimum superheating temperature (for various freezing temperatures) in order to avoid the formation of bears. The formulas given can be used to repeat the calculations noted above under similar conditions. GN(12b)

Rolling (12c)

Spraying System for Descaling Hot Steel. J. E. Holveck (V. P. Aldrich Pump Co.). *Iron & Steel Engineer*, Vol. 8, Aug. 1931, pages 362–368.

The use of high pressure water spray descaling hot slabs in the various stages of rolling is described. Data on the amount of water required, pressure and nozzle spacing are given. The author favors an hydro-pneumatic accumulator for taking care of the peak demand (which may be 300% above the average) instead of pumps of total capacity equal to the peak demand. An improved type of pump is described. WHK(12c)

Roll Pass Design. Part XXVI. W. Trinks (Carnegie Institute of Technology). *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 99–105.

Discusses design of 3-high blooming mills and 2-high tandem blooming mills and illustrated operation of each type with examples, giving complete tables of data on rolls, passes, working characteristics, etc. with reasons for special design features. In the 3-high mill, the groove in the middle roll meets corresponding grooves in both the top and bottom rolls. Top and bottom passes alternate, but edging occurs only with the bottom passes. Drafts are much heavier in the bottom passes. The rolls in 3-high mills work with higher stresses than those in 2-high mills and undergo considerable wear. Both 2-high reversing mills and 3-high mills are hard on steel because of the heavy draft, the high speed of deformation and the use of box passes. The objections are overcome by the newly-developed "monkey rolls" used in 2-high tandem blooming mills. These operate more slowly than a reversing mill and produce excellent blooms. Each roll has but one groove and permits box, oval or diamond passes. Edging is performed after each pass. The torque and horse-power requirements are quite low. JN(12c)

Explanation of Spreading During Rolling with the Help of the Surface Strain Theory. (**Die Klärung der Breitungsfrage beim Walzen mit Hilfe der Spannungsflächenhypothese.**) W. TAFEL & W. KNOLL. *Metallwirtschaft*, Vol. 10, Oct. 16, 1931, pages 799–806.

20 references. A theoretical discussion. Starting with Tafel's hypothesis of tension triangles a formula for calculating spreading, or increase in width, during rolling is developed, which can be universally applied, in contrast to older formulas. The influence of roll diameter and width of bar on spreading was investigated and is explained by the spreading hypothesis. The application of the formula to Pb, Cu and Al is elaborated. 3 sets of curves are given by which spreading can be calculated in a short time. CEM(12c)

The Orientation of Rolled Aluminium. J. THEWLIS. *London, Edinburgh and Dublin Philosophical Magazine & Journal of Science*, Vol. 10, Nov. 1930, pages 953–961.

Deals with flat-rolled and square-rolled aluminum. For the flat-rolled, no definite direction in the crystal can be identified with the rolling direction or the normal direction. A square-rolled rod rolled from an aluminum rod possessing random orientation has the same orientation as a cold-drawn aluminum wire. RHP(12c)

Theory and Practice of Rolling Steel. W. TAFEL, translated by RICHARD RIMBACH. Penton Publishing Co., Cleveland, 1931. 2nd edition. Cloth, $6\frac{1}{4} \times 9\frac{1}{4}$ inches, 304 pages. Price $6.00.

Although the first edition was only published in 1927, a second edition has been required. Minor revision has been made throughout, and the chapter on "Power for and method of driving roll trains" has been amplified.

The book also covers the theories and rules of rolling, technical conceptions of rolling, pass design and arrangement of rolls, merchant bars and special shapes. It is replete with illustrative drawings, which aid greatly in understanding the geometry of rod design and the mode of deformation of the metal.

This is not merely a cook-book of empirical roll designs for the production of a given shape; instead it deals with fundamental principles and their application, so presented that the reader may grasp the reasoning required for a successful solution of a problem in roll pass design even though it may not be among those dealt with in detail in the book.—H. W. Gillett (12c)-B-

The Production of Copper Tubes. A. SCHUMMEL. *Metal Industry*, London, Vol. 39, July 31, 1931, pages 98, 101.

Abstracted from *Technische Blatter*. The method of manufacture of seamless copper tubes depends on dimensions of tubes; the Mannesmann process is most general, though tubes up to 50 mm. diameter are made by press processes. PRK(12c)

The Use of Roller Bearings in Rolling Mills. (**Ueber die Einführung von Rollenlagern in Walzwerken.**) G. PALMGREN. *Revue Technique Luxembourgeoise*, Vol. 23, May-June 1931, pages 109–121.

Several installations are described to illustrate the wide use recently attained by roller bearings of the SKF type. Construction details are given with curves showing the difference in power consumption between ordinary and roller bearings. Beside saving in energy consumption, the rolls themselves are less subject to wear because they do not get out of alignment so easily and the product is, therefore, of more uniform gage. Ha(12c)

The Heating of Billets for Merchant Mills. U. A. PETERS. *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 109–110, 124.

Stock billets range in size from $1\frac{3}{4}$ in. square to 8 in. square. For rolling bar sections of soft steel, billets must be heated uniformly at a temperature between 2150° and 1550° F. The old type of in and out heating furnace has an average thermal head of 1500° F. with a heat penetration of $\frac{1}{8}$ in./min. The continuous heating furnace has an average thermal head of 600° F. with a heat penetration of only $\frac{1}{20}$ in./min. The latter discharges a far more uniformly heated billet. Heating losses vary inversely with the width of the bar. JN(12c)

Fabrication of Automobile Body Sheet. (**Fabrication des tôles pour carrosserie d'automobiles.**) D. TACCONE. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 313–319.

Describes various methods and indicates that continuous rolling and continuous normalizing will ultimately have to be adopted everywhere. HWG(12c)

Shearing & Punching (12e)

Design and Construction of Hot Saws for Cutting Heavy Sections. A. B. PEARSON. *Transactions American Society of Mechanical Engineers*, Vol. 52, Part 1, *Iron & Steel*, pages 105–112.

Includes discussion. See *Metals & Alloys*, Vol. 2, July 1931, page 135. (12e)

Metal Working in Power Presses. E. V. CRANE. *Metal Stampings*, Vol. 4, Apr. 1931, page 336.

Abstract of a paper presented at the New York Meeting of the American Institute of Mining & Metallurgical Engineers, week of Feb. 16, 1931. See *Metals and Alloys*, Vol. 2, May 1931, page 106. JN(12e)

Machining (12g)

Machining Aircraft Cylinder Heads. H. C. DECKARD. *Western Machinery World*, Vol. 22, Sept. 1931, pages 389–391.

There are 28 operations required before the cylinder barrel and head of an aircraft engine are ready to be assembled. These operations are described briefly. The cylinder assembly is composed of 14 parts; these are enumerated. WAT(12g)

Results with Widia Tool Metal. (**Leistungsergebnisse mit Widia-Werkzeugmetall.**) A. FEHSE. *Maschinenbau*, Vol. 10, No. 5, 1931, pages 161–173.

Because of its long life and the possibility of applying it in thin layers on the carrying metal, Widia metal is very economical. The cutting velocity is 70 m./min. for high speed steel. The cutting capacity for C steel is 0.65 kg. in 1.7 min.; for high speed steel it is 6.1 kg. in 3.2 min.; for Widia, 58 kg. in 16.5 min. It can be used equally well for cutting and drilling insulating materials (marble, slate, glass, etc.) Ha(12g)

Application of Drill Jigs to Metal Stampings. CARLE SIZALANCZY (Westinghouse Electric & Mfg. Co.). *Metal Stampings*, Vol. 3, July 1930, pages 655–658.

When holes smaller in diameter than the thickness of metal in a stamping must be produced, or when the walls between punches are frail, it has been found advantageous to drill the required holes by means of drilling jigs. Illustrates construction of both single and multiple jigs. MS(12g)

The Action of Cutting Tools. H. A. SCHWARTZ. *Iron & Steel of Canada*, Vol. 14, Mar. 1931, pages 45–46.

A short article, accompanied by 5 diagrams, in which the importance of tool design, the causes of tool failure, and the purpose of cutting oil are discussed. Some consideration is given to the factors controlling tool life and reference is made to the work of various experts in this field. OWE(12g)

New Investigations on the Theory of Cutting and Machineability. (**Neue Untersuchungen zur Schnitt theorie und Bearbeitbarkeit.**) F. SCHWERD. *Stahl und Eisen*, Vol. 51, Apr. 16, 1931, pages 481–491.

Report No. 171 of the Committee on Materials of the Verein deutscher Eisenhüttenleute. Includes discussion. After discussing the results of previous investigations, the author describes a new apparatus to study the occurrences on the cutting edge and summarizes the results of his tests in machining open hearth steel, cast iron, Al, Cu and bronze with various depths of cut and different cutting speeds. The investigation particularly aims to study the occurrences on the cutting edge of the tool. This was done by applying the spark cinematography which allowed 10 pictures to be taken within $\frac{1}{1000}$ sec. with a time of exposure of $\frac{1}{1,000,000}$ sec. In cutting tough materials with a slow speed, a crust is formed on the edge of the tool. At high velocities, no crust is formed. In cutting open hearth steel, the speed was determined above which no crust occurs. The crust formed continually changes in size in time intervals of several tenths of a sec. The relations between the crust and the surface condition of the material machined were studied. The surface of the material is always destroyed when a crust is formed. Cracks originate as do also distortions of the surface up to one half of the depth of cut when the crust is formed with slow cutting speeds. High speeds and, therefore, the absence of crusts give sound and smooth surfaces. The crystal grains near the surface are distorted in slow cutting. A crust is formed even with light depths of cut (0.05 mm.). No distortion of the structure occurs in high speed cutting. In machining brittle materials, as cast iron or aluminum, the material is split, torn and destroyed without formation of a crust upon the cutting edge. GN(12g)

Cooling and Lubrication in Machining Cast Iron. (**Kühlen und Schmieren bei der Gusseisenzerspannung.**) A. WALLICHS & K. KREKELER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, June 19, 1931, pages 493–495.

Comprehensive tests were made in machining cast iron dry and wet with an oil emulsion. Under proper conditions, the cutting velocity could sometimes be increased by 50%, but in any case, a considerable gain could be stated. Ha(12g)

Boring and Reaming of Iron, Copper, and Aluminum Alloys. (**Untersuchungen über das Senken and Reiben von Eisen-, Kupfer- und Aluminium-Legierungen.**) H. SCHALLBROCH (Tech. Hochschule, Aachen). Thesis for Dipl-Ingr., E. Wedler & Co., Aachen, July 18, 1930, 23 pages, 36 figures, 16 references.

Curves are shown for energy required in boring and reaming holes of different diameters with different depths of cut at varying feeds, in cast irons (10,000 and 30,000 lbs./in.^{2} tensile; 87 and 178 Brinell); 0.17% C steel (53,000–114); 0.45% C steel (85,000–182); 0.35% C, $1\frac{1}{2}$% Ni, $\frac{1}{2}$% Cr heat-treated steel (120,000–232); 0.35% C, $3\frac{1}{2}$% Ni, $\frac{3}{4}$% Cr heat-treated steel (135,000–285); cast brass of 63% Cu, 35% Zn, 2% Pb (31,000–55); red brass of 85% Cu, 5% Sn, 7% Zn, 3% Pb (25,000–80); leaded bronze of 80% Cu, 8% Sn, 12% Pb (25,000–67); gun metal, 84% Cu, 14% Sn (34,000–128); in 99.3% Al (14,000–25); silumin $86\frac{1}{2}$% Al, 13% Si, $\frac{1}{2}$% Cu (24,000 to 33,000–48) and in heat-treated Lautal, 94% Al, 4% Cu, 2% Si (54,000 to 60,000–95). The data are too extensive for abstracting in detail. The effect of different coolants upon the power required and on the excess of actual diameter over nominal diameter was studied. With cast iron the average increase in diameter of hole was slightly less with a cutting emulsion than with rapeseed oil with which in time it was slightly less than with mineral oil. The steels gave best results with emulsion, mineral oil next, rapeseed third. The copper alloys gave the same results with emulsion and rapeseed oil, mineral oil being slightly poorer. The aluminum alloys showed much greater differences in size of hole than did the other alloys, a mixture of 5 parts gasoline, 4 parts turpentine worked best, rapeseed next, emulsion third. On all alloys, dry cutting gave worse results than cutting with a coolant, though only slightly so on the copper alloys.—H. W. Gillett (12g)-B-

New Developments in Machining Aluminium and Its Alloys. R. L. TEMPLIN. *Metal Industry*, London, Vol. 38, Apr. 24, 1931, pages 433–434.

Condensed from a paper read before the Society of Automotive Engineers at Detroit. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 43. PRK(12g)

Tool Engineering. J. M. RITTNER. *Western Machinery World*, Vol. 22, Sept. 1931, pages 392–394.

The general requirements necessary for the efficient operation and working of jigs is set forth briefly. WAT(12g)

Standards for Surface Finishes. S. M. RANSOME (Barber-Colman Co.). *American Machinist*, Vol. 74, Apr. 9, 1931, page 581.

The Barber-Coleman Co. has prepared a set of sample bars showing 6 different finishes from a dead smooth surface to a rough machine finish. These with a brief printed description are distributed throughout the shop and drafting room as a standard for finishes. RHP(12g)

Accurate Testing of Machines by Energy Measurements. (**Genauigkeitsprüfung von Werkzeugmaschinen durch Energie Messung.**) CLAUS SCHUMACHER. *Maschinenbau*, Vol. 10, July 18, 1931, pages 415–418; July 2, 1931, pages 446–449.

The significance of accurate testing of machines in motion by measurement with a recording watt meter is presented. The importance of conditions previous to testing is emphasized. For the special case of a multi-axle motor, an accurate representation of the calculation of 4 drum brakes for artificial production is made. The essence of testing the charge is discussed by means of diagrams. An evaluation of the Watt lines of multi-axled motors is made, while the basis for a numerical estimate of motor standardization is presented in a new way. This new conception may express the efficiency of the motor with reference to its use in practice, and may also evaluate numerically the efficiency of the curve showing the voltage used. MAB(12g)

Drawing & Stamping (12h)

Commercial Types of Power Presses. Part III. Single Action Drawing Presses and Attachments. E. V. CRANE (E. W. Bliss Co.). *Metal Stampings*, Vol. 4, Apr. 1931, pages 317–320.

For single action drawing or redrawing, the presses commonly used are the standard stroke presses, the straight side and gap frame types of presses and the long stroke reducing presses. All of these have the ordinary crank motion. The slow draw drive presses use a modification of the crank motion. These give a uniform and constant drawing velocity but materially speed up the return stroke. The rack and pinion type of press is used for extremely long strokes. This has a limited speed of 16–36 ft./min. but the return speed is faster than the down stroke. A new type of crank motion press developed for greater speeds shows an average velocity of 108 ft./min. in reducing brass shell. In the Fulton-Sylphon process, each draw is accomplished by means of a number of relatively short crank motions in a long-frame, horizontal press. Reductions of 40–50% in wall thickness per operation are reported at speeds of 80–320 in./min. Al, Cu, Zn and brass tubing have been produced of remarkable uniformity in lengths up to 10 ft. JN(12h)

Plastic Drawing of Sheet Steel into Shapes. E. V. CRANE (E. W. Bliss Co.). *American Society for Steel Treating, Preprint* No. 18, 1931, 21 pages.

Paper to be read and discussed before the Boston Convention of the Society in Sept. 1931. Principles developed in the study of the plastic deformation (cold) of metal into round shells are discussed. Surface markings developed during the working, plastic movement, breakage and strain hardening, annealing troubles and die construction are discussed. WLC(12h)

Increasing Value of Scrap Metals from Stamping Operations. JAMES SILBERSTEIN. *Metal Stampings*, Vol. 3, Aug. 1930, pages 717–720.
Unless a stamping plant operates a foundry, the scrap is sold. Price paid depends on its freedom from contamination. Outlines classifications necessary for obtaining highest prices for Cu, brass, bronze, Ni, Monel metal, German silver and Al. Describes some rapid tests for classifying alloys of similar appearance but different chemical composition. MS(12h)

Investigations on the Course of Deformation of the Technical Shaping Methods. (Untersuchungen über den Formänderungsverlauf bei technischen Formgebungsverfahren.) E. SIEBEL & H. HÜHNE. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 3, 1931, *Report* No. 173, pages 43–62; *Stahl und Eisen*, Vol. 51, May 7, 1931, page 597.
After theoretical considerations, the authors give the result of their investigations on the state of deformation of a material during drawing, pressing, stamping and rolling. GN(12h)

Investigations on the Power Consumption in Pressing and Stamping. (Untersuchungen über den Kraftbedarf bein Pressen und Lochen.) E. SIEBEL & E. FANGMEIER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 2, 1931, *Report* No. 172, pages 29–41; *Stahl und Eisen*, Vol. 51, May 7, 1931, page 597.
The authors found in their investigations that the power consumption in pressing and stamping can be determined from the work required for shaping which is the product of deformed volume, resistance to deformation and the principal change of shape. Theoretical considerations lead to the development of a formula to express the power consumption. The theory was tested in pressing and stamping experiments with lead and later in investigating the various technical processes of pressing and stamping. GN(12h)

Estimating Material Requirements for Stampings. J. K. OLSEN. *Metal Stampings*, Vol. 3, Oct. 1930, pages 897–900.
Gives table of commercial and preferred gates or sizes, exact weight in lb./in.^{2}, and constant for weight in lbs. per 100 pieces plus 5% scrap for sheets, strips and bar stock of various metals and alloys used in stamping manufacturing. MS(12h)

Simplified Method of Determining Weight of Sheet or Strip Stock. J. K. OLSEN. *Metal Stampings*, Vol. 3, July 1930, pages 663–664.
Gives typical calculations and table for simplifying the computation of brass stock for production stamping jobs. MS(12h)

Lubricants for Deep Drawing. MAURICE RESWICK.(Penna. Lubricating Co.). *Metal Progress*, Vol. 20, Sept. 1931, pages 69–73.
A paper read before the Sept. Convention of the American Society for Steel Treating in Boston. Failure to recognize the real purpose of lubricants for deep drawing has led to much expensive "out and try" search for satisfactory lubricants. The primary function of a lubricant is to prevent metal to metal contact between the work and the dies and to decrease the sliding friction to a minimum. The quality of a lubricant must be measured by its performance on the job. The qualities essential are (1) film strength that will not break down under the operating pressures and thin out under the temperatures resulting from the heat of friction; (2) oiliness or low coefficient of friction between die and work must be obtained; (3) the lubricant must adhere to the metal surface and spread ahead of the working pressure; (4) must be easily cleaned from the work; (5) must have no corrosive action on the dies or work; (6) the lubricant must be stable; (7) it must have no physiological effect; (8) odors or perfuming should be avoided; (9) the lubricant should undergo no changes in properties with change in climatic conditions; (10) the drawing compound should be inexpensive on the basis of quality and amount of work done per die. Not all these ideals may be attained simultaneously and every grease is a compromise. Lubricants must be developed according to conditions. Tallow and mineral oil are discussed. Use of fillers and compounding of oils are discussed. Typical analyses are given with this discussion. WLC(12h)

Handbook of Deep-drawing Technology. (Handbuch der Ziehtechnik.) W. SELLIN. Julius Springer Verlag, Berlin, 1931. Cloth, $6^1/_2 \times 9^1/_2$ inches, 360 pages, 371 figs. Price 32 RM.
This is a book that would deserve translation into English. It discusses the principles of the deformation during deep-drawing, the effect of die form and die clearance, the difficulties met, graphic and mathematical methods for calculation of the amount of stock necessary to form a given piece, and goes into great detail in the discussion of all kinds of presses, shears and accessories. Copious illustrations, photographs, sketches and curves are used. The book is beautifully printed, and has an index. The important factors in deep-drawing are the sheet, the die and the machine. Each is discussed in detail. Curves are given showing the Erichsen values for various alloys in various thicknesses. Evaluation of quality of sheet seems to be chiefly through tensile and Erichsen values, though hardness testing is described, and a drawing test in which the power required can be measured, is also mentioned. Some attention is paid to annealing methods and equipment, and brief mention is given to heat-treatment of dies. The metallurgical aspects of the problem are not as adequately treated as the mechanical ones, however. Cost estimation and the economics of production receive some attention as do precautions for the safety of the operators. The handbook is a distinct addition to the literature of the subject, and an English edition would be acceptable.—H. W. Gillett (12h)-B-

Pressing Plant for the Production of Seamless Drawn Hollow Bodies. (Presswerk zur Herstellung von nahtlos gezogenen Hohlkörpern.) S. WEIL. *Stahl und Eisen*, Vol. 51, Sept. 3, 1931, pages 1119–1120.
Detailed and illustrated description of a press plant producing seamless bodies up to 1450 mm. diameter and 8500 mm. length. GN(12h)

How Steel Bends. D. C. BAILEY. *American Machinist*, Vol. 74, June 4, 1931, pages 865–867.
Explanation of a method for the simple calculation of the exact width of metal required for any particular section in folding or rolling metal channels and moldings. A monographic chart is developed and its application is illustrated. Ha(12h)

Sheet Steel, Its Drawing Quality. THOMAS DOCKRAY (Eastern Rolling Mill Co.). *Metal Progress*, Vol. 20, Oct. 1931, pages 54–59.
The effect of the principal mill operations of hot rolling, normalizing, box annealing, cold rolling, steel quality, and age on the properties of sheet steel are discussed. Application of test methods to selection of material is discussed. Much space is devoted to the interesting subject of aging and its effect upon the properties of sheets. WLC(12h)

Pickling (12i)

Black Pickling of Brass. (Schwarzbeizen von Messing.) K. SCHUCH. *Oberflächentechnik*, Vol. 18, Aug. 4, 1931, page 163.
The following saturated solution is recommended: 150 g. copper carbonate, 750 g. ammonia and 150 g. water. The pickling should be over in 3–8 mins. If the solution is heated to 40–50° C., it takes less time. Several modifications of the method are discussed according to the purpose and the composition of the objects. Ha(12i)

Action of Inhibitors in Metal Pickling. (Ueber die Wirkungsweise von Sparbeiz-zusatzen bei der Metallbeizung.) H. PIRAK & W. WENZEL. *Metallbörse*, Vol. 20, Nov. 15, 1930, pages 2539–2540; Nov. 22, 1930, page 2589.
A review of various theories. Some preference is given to that of Chappell, Roetheli and McCarty. WHB(12i)

Cold Working (12j)

The Construction and Uses of Shape Bending Machines. D. A. JOHNSTON (Kane & Roach, Inc.). *Metal Stampings*, Vol. 4, Feb. 1931, pages 121–126, 134.
Gives list of most common applications of bending equipment and describes and illustrates the 4 main classifications of benders, i. e., pyramid, pinch, wrap and full wrap, showing various vertical and horizontal types of each. Also discusses capacities of different types and sizes of machines and the roll arrangements and special and standard rolls employed in making the various bends. JN(12j)

The Design and Application of Straighteners. Part II. D. A. JOHNSTON (Kane & Roach, Inc.). *Metal Stampings*, Vol. 4, Mar. 1931, pages 215–219.
Most standard roll straighteners consist of a succession of staggered top and bottom rolls with the top rolls adjustable. Usually, only the bottom rolls are gear driven. To straighten a bar, the rolls are set to give it a series of new sweeping bends. These absorb all the original kinks and bends and remove most of the internal stress. To straighten angles, a one-way roll straightener is used which operates against the crotch. A two-way or combination straightener with both vertical and horizontal rolls is also used which operates against the back of the angle. Rotary straighteners are widely used for round bars, pipe and tubing where the highest accuracy is desired. Here, the work rotates between rolls tipped at an angle. One type straightens automobile axle shafts, drive shafts, etc., at a speed of 30 ft./min. Another type straightens bars at high speeds up to 450 ft./min. JN(12j)

The Institution of Automobile Engineers. Pressings for Automobiles. J. C. ARROWSMITH. *Automobile Engineer*, Vol. 21, July 1931, pages 272–278.
There has been a considerable tendency of late years to substitute cold pressings for hot, where possible. Hot pressing was formerly a necessity on account of the limited power available, but with the development of the powerful press equipment of to-day that difficulty has been largely overcome. At the same time, it has been necessary for the steelmakers to supply material suitable for cold pressings and considerable advances have been made in this direction. It is now possible to cold press all the members which go to make up a chassis frame and in many instances to punch all the necessary rivet holes during the blanking operation. The great advantage offered by cold pressing is that the cost of production is lower, since the rate of production is much higher and the wear on the dies is less severe since lubrication is possible. The strength and reliability of cold-pressed parts have for a long time been well established. It is occasionally put forward that, as it is necessary to use material of a lower initial tensile strength for cold pressing, the strength/weight ratio is higher in the case of hot pressings. It should, however, be borne in mind that while the physical properties of the steel of a hot pressing remain unchanged by the pressing operation, a cold pressed article is actually strengthened by the cold work put upon it. (12j)

Cracking of Cold Drawn Steel Bars. (Ueber das Aufreissen von kaltgezogenem Rundeisen.) W. FAHRENHORST & G. SACHS. *Metallwirtschaft*, Vol. 10, Oct. 9, 1931, pages 783–788.
4 references. Certain types of steel have a tendency to tear or crack, similar to brass, during cold drawing, polishing and automatic machining processes. Round bars containing 0.06 C, 0.41 Mn, 0.06 P and 0.04 S produced under various practices were hot rolled to 42 to 46 mm. diameter, then cold rolled in one pass to 40 mm. diameter and polished. 5 of the bars cracked during cold rolling. The cracking had no relation to the method of pouring or deoxidizing, top or bottom of ingot, diameter of hot rolled bar or out of roundness, impact strength or hardness of the finished bars. The impact strength of bars from Al killed ingots was 100% higher than from those not killed with Al, and those from the bottom of the ingot were 30% higher than from the top of the ingot. The internal longitudinal, tangential and radial strains remaining in the bars due to cold working were determined by drilling the bars stepwise and measuring changes in diameter and length. The results are shown graphically and are surprisingly high. Polishing lowers the strains considerably, especially in the center of the bars, while near the surface they are reversed. It is reasonable that with tangential strains of 30 kg./mm.^{2}, bars with minute inclusions near the surface or other slight defects will crack. 3 methods of preventing these strains are proposed: (1) annealing at 500° C., (2) straining the bars after drawing beyond the yield point, (3) increasing the reduction in diameter during drawing so that the metal flows when it leaves the die. CEM(12j)

Hardness of Metals and Alloys as a Function of Cold Work. (Les variations de dureté de certains métaux et alliages en fonction de l'écrouissage.) GUICHARD, CLAUSMANN & BILLON. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 527–532.
Study of various coinage alloys. The rate of hardening of Ag, Ni, Cu, aluminum bronze, coinage bronze, cupro nickel, Au-Cu and Ag-Cu alloys is plotted. Some show slow increase of hardness at the higher deformations, but after around 60% reduction, cupro nickel, Ni, aluminum bronze and coinage bronze do not get harder on further reduction. Some comment is made on methods of hardness determination by Baby Brinell on thin sheets. HWG(12j)

Influence of Initial Condition on Hardening of Metals and Alloys in Cold Work. (L'influence de l'état initial de certains métaux et alliages sur la variation de dureté par écrouissage.) GUICHARD, CLAUSMANN & BILLON. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 533–534.
The hardness curves of Cu, Ag and some of their coinage alloys, plotted against percentage deformation, are approximately parallel, but the curve for the material cold rolled from the as-cast condition lies higher than that for material rolled from the annealed condition. HWG(12j)

Bending Dies for Press Brakes. F. H. PFEFFERLE (Cincinnati Shaper Co.). *Metal Stampings*, Vol. 4, Apr. 1931, pages 325–328, 336.
Describes and illustrates the simple types of bending dies used in press brakes for making acute angles, hems, 90° bends and offset bends. These bends are all made by using combinations of the appropriate single dies in pairs. 4-Way bending dies are equivalent to 4 single dies. They are made square with an opening in each side and are used in combination with one or more single dies for forming a range of metals from $^1/_8$ to $^3/_8$ in. in thickness. Radius dies are used for making right angle bends of comparatively large radii. Special dies are employed for making U-bends. Solid dies require 2 or 3 operations to produce a U-bend with parallel sides, while a pair of folding dies will do this in one operation. JN(12j)

The Construction and Uses of Levellers. Part III. D. A. JOHNSTON (Kane & Roach, Inc.). *Metal Stampings*, Vol. 4, Apr. 1931, pages 309–312.
Gives photographs and descriptions of a number of commercial levelling machines for wide sheet and strip stock, including capacities, speed, type of rolls, nature of drive and means of lubrication of each. JN(12j)

Tammann's Investigations on Cold Working, Strain Hardening and Recrystallization. (Tammann's Untersuchungen über Kaltreckung, Verfestigung und Rekristallisation.) G. MASING. *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 139–142, 14 references.
The well-known statements of Tammann concerning phenomena involved in the plastic deformation and recrystallization are summarized. EF(12j)

Overstrain of Metals. MAJOR A. C. MACRAE. His Majesty's Stationery Office, London, 1930. Cloth, 6 × 9½ inches, 369 pages. Price 1£ 1s.

By giving a gun forging a slight permanent set by means of hydraulic pressure internally applied, followed by a low-temperature heat-treatment, the effective elastic limit may be raised. This auto-frettage process has been studied theoretically and practically. The theory and the mathematical calculations, as well as the experimental results on Ni, Ni Cr, and Ni Cr Mo gun steels, are given in great detail. The hydraulic apparatus used is described and the manufacture of 3 in. guns from monobloc forgings described clear through to the final firing tests.

Experiments were also made showing the applicability of the process to larger guns of built-up structure. A strain under load of 2½% was used, instead of 6% as in arsenals of some other countries, since in 2 particular cases studied the gain in safe pressure was only 5000 to 8000 lbs./in.^{2}

The report is written in a more or less chronological order with a vast deal of detail, so that much of it is in the nature of repetition, interspersed with mathematical calculations of what should happen according to theory in each experiment and experimental proof that it did so happen. Being apparently made up of a series of progress reports without a single clear summary, it is rather tedious reading, since the whole has to be read to follow the argument. It can be more readily followed if one first reads the briefer paper, "Effect of Cold Working on the Strength of Hollow Cylinders," by F. C. Langenberg, *Transactions American Society for Steel Treating*, Vol. 8, 1925, page 447.

The process is of such importance in the manufacture of guns, and can obviously be applied to pressure vessels, so that those who are interested will be grateful for the great amount of detail and be willing to spend the time necessary to follow the author's argument.

The method of making big guns by auto-frettage is so logical that all modern arsenals are doubtless about equally advanced in knowledge of the process, so that the publication probably does not give the arsenals of other nations anything they did not know already. The publication would be of more value to the non-military reader if it had been written from a more general point of view, even at the loss of some of the detail.—H. W. Gillett (12j)-B-

Calculation of the Rolls of Bending Machines. RÉNÉ TILKIN. *Iron Age*, Vol. 128, July 30, 1931, pages 315–318.

Object is to design rolls which will have the least deformation. Gives method of calculating rolls of bending machines, where these rolls are supported at the 2 ends and also at the center. Considers also deflection of the roll itself and effects of backing up. VSP(12j)

Cleaning (12k)

Cleaning of Metal. Pt. XI-XII. R. W. MITCHELL. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, pages 935–945; Dec. 1930, pages 1025–1031.

Includes bibliography of 12 references. Compares the properties of various detergent materials, and discusses value of colloidal properties in a cleaning solution, optimum alkalinity range for fast cleaning, corrosion of metal being cleaned, temperatures, systems of cleaning, handling methods, choice of lubricants, and value of prompt cleaning. MS(12k)

The Bullard Dunn Process of Cleaning. FLOYD T. TAYLOR. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, pages 394–395.

This process is carried out in a dilute solution of chlorides and sulphuric acid with Pb anodes and a current density of 60–77 amp./ft.^{2} Pb is plated out on the cleaned metal which is the cathode. PRK(12k)

Polishing & Grinding (12l)

Material Alone Is Not the Determining Factor in Selecting Grinding Wheel. A. ROUSSEAU. *Grits & Grinds*, Vol. 22, July 1931, pages 7–10.

It is pointed out that the selection of a grinding wheel has to be made according to the material to be ground, the nature of the work to be done and the physical properties of the material to be ground. The factors determining the characteristics of a wheel are the abrasive (aluminum oxide or silicon carbide), the grain size, the grade (resistance of abrasive grains to pulling out from the wheel), the structure (spacing of abrasive grains) and the bond. An example designates the manner of making a selection. Ha(12l)

Recent Developments in the Art of Roll Grinding. LLOYD A. PAINE. *Grits & Grinds*, Vol. 22, July 1931, pages 1–6.

After a discussion of the requirements of the surface of rolls, a grinder made of "Crystolon" abrasive by the Norton Co. is described. This grinder has sufficient cutting ability to remove stock up to 0.003 in. and can also be used to give a reflective finish with a hard, clean-bottomed surface. This combination reduces the grinding time to less than half. Ha(12l)

Grinding and Heat Treatment as a Cause of Cracks in Hardened Steels. C. E. SWEETSER. *Heat Treating & Forging*, Vol. 17, Aug. 1931, pages 776–780.

The effects of abusive heat treatment and abusive grinding are explained from tests made with a number of samples. See also *Metals & Alloys*, Vol. 2, Sept. 1930, page 738. Ha(12l)

Form Grinding in Successive Operations. WM. C. BETZ. *American Machinist*, Vol. 74, June 11, 1931, pages 901–902.

Suggestions for economical grinding of forms in precision tool and die making. Ha(12l)

Ball Burnishing Hardware. F. M. BENWAY. *Metal Industry*, N. Y., Vol. 29, Oct. 1931, page 438.

High quality buffing is accomplished by rolling the pieces in barrels filled with special balls of various sizes. PRK(12l)

Metal Polishing by Flexible Polishing Wheels. EDWIN M. BAKER & GEORGE E. HOLBROOK. *Metal Industry*, N. Y., Vol. 29, Aug. 1931, pages 346–349; Sept. 1931, pages 388–389.

Paper presented before The Electrochemical Society, Apr. 23–25, 1931. Using a small polishing machine it was shown that: with coarse grain abrasive, increasing the pressure between steel being polished and wheel, the cutting speed is cut proportionally, but the efficiency is decreased, the optimum pressure being 0.5–1 kg./cm. width of wheel; with fine grain abrasive, increase in pressure above 0.5 kg./cm. width of wheel has little effect on cutting speed with but slight decrease in efficiency. Closely sized grain are much more efficient but have same cutting speed as loosely sized grain. Top dressing on wheels with fine grain reduces cutting speed but does not affect efficiency, whereas, with coarse grain, efficiency is increased with only moderate decrease in cutting speed. PRK(12l)

Metal Polishing. F. H. HOBBS. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, page 393.

Practical observations on metal polishing are given. PRK(12l)

To Grind or Not to Grind. A. M. HAMMOND. *Modern Machine Shop*, Vol. 4, July 1931, pages 28–32.

The advantages over other finishing methods, for certain classes of work, of the face grinding machine are pointed out. First cost and up-keep may be frequently cheaper and a saving in material can often be effected. Ha(12l)

The First Institute for Grinding Technique in a German Technical University and the Application of Grinding in Industry and Commerce. (Das erste Institut für Schleiftechnik an einer deutschen Hochschule und die Anwendung des Schleifens in Industrie und Gewerbe.) MANGOLD. *Oberflächentechnik*, Vol. 7, Aug. 1930, pages 153–154.

The importance of exact grinding in obtaining the accuracy in machining required in modern industry is pointed out and the often neglected technique of grinding is discussed. The Technical University of Braunschweig was the first to install a chair for this branch of metal working. A brief discussion of the development and application of grinding technique, application of natural and artificial grinding materials and the grinding wheel for precision work follows. Ha(12l)

Ball Burnishing Small Parts. CARL F. WEBER. *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 773–774.

In burnishing before Ni plating, parts are placed in a horizontal barrel, rotating at 30 r.p.m., with enough sawdust to clean and prevent scratching them. When clean, the parts are separated from the sawdust, immersed in a boiling commercial cleaning solution for 15 mins., and rinsed in cold running H_2O. They are then dipped in strong HCl for 5–10 mins. and rinsed again. They are next placed in the burnishing barrel with enough balls so that the contents come to within 4–6 ins. of the top of the barrel. About 200 lbs. of balls are used in a barrel 2 ft. deep by 11 ins. in diam. One-half gal. of soft soap is added and the barrel is filled with cold H_2O. The barrel is rotated for 1½–1¾ hr., after which, the contents are emptied into a sieve where the balls and parts are separate. The latter are rinsed, and then dried in sawdust. If they are to be plated immediately, they are cleaned and prepared for plating in the usual manner. After plating, the parts are immersed in a storage tank containing soap solution. In burnishing, the same procedure is followed as in burnishing before plating, except that the barrel is rotated for 40–60 mins. Balls and barrels should be cleaned with a solution of NaCN. MS(12l)

Keeping Qualities of Abrasives. HENRY R. POWER. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1035–1037.

Common abrasives lose their capillarity value, when contaminated with moisture, oil, and dust, thus causing a reduction of the efficiency of the abrasive. A product has been developed which is no longer affected by absorption of moisture, so that ordinary storage can be used for this kind of abrasive. MS(12l)

Stresses and Cracks in Hardened and Ground Steel. GERALD R. BROPHY (General Electric Co.). *Transactions American Society for Steel Treating*, Vol. 18, 1930, pages 423–439.

Paper presented before the Twelfth Annual Convention of the Society, Chicago, September 1930. Includes discussion, 7 references to the literature and is illustrated by 39 photographs of ground surfaces. The author describes a method of detecting the location and intensity of stresses by acid etching. The larger the stresses the weaker the acid necessary to detect it. Moderate heating after quenching relieves quenching stresses and in like manner such heating after grinding relieves grinding stresses. Reheating of precision parts to 300° F. after a rough grind followed by a very careful finish is recommended. WLC(12l)

Increasing the Efficiency of Commercial Metal Polishing. E. M. BAKER & G. E. HOLBROOK. *Monthly Review American Electroplaters' Society*, Vol. 18, Apr. 1931, pages 22–32.

An experimental polishing arrangement is described with which the polishing process was to be investigated as to possibilities of higher efficiency because it had been found from the examination of the dust collected near a polishing wheel that about 50% of it was simply the same polishing grain thrown off from the wheel before it had done any work. Some of the conclusions of the experiments were that coarse grain (No. 46), doubling the pressure between wheel and steel being polished, will approximately double the quantity of steel polished away and quadruple the wheel wear per ft.^{2} of the steel polished. With fine grain (No. 150) the increase of pressure influences only slightly the quantity of polished-away steel and wheel wear. The use of polishing glue increases the wheel life for coarse grains, but not for finer grains. Closely sized grain is much more efficient than loosely sized grain. The characteristics of polishing glue, setting up polishing wheels, drying room conditions, the sizing of polishing grains are discussed. Ha(12l)

Selecting the Proper Buffing and Polishing Compound. P. W. ELLWANGER. *Metal Cleaning & Finishing*, Vol. 2, Nov. 1930, pages 955–956, 960.

General discussion of various factors influencing the selection of polishing and buffing compositions. MS(12l)

Tests for Determining the Temperature of the Surface of a Cut Section in Grinding Through Steel. (Versuche zur Ermittlung der Schnittflächentemperatur beim Durchschleifen von Stahl.) SILVIUS CRISAN. *Das Werkzeug* (supplement to *Maschinenkonstrukteur-Betriebstechnik*), Vol. 7, June 25, 1931, pages 133–135.

The grinding is done by means of slipping disks of 2.4–3.0 mm. thickness and 300 or 400 mm. diameter, at an average forward rate of 0.5 m./minute and a cutting rate (total velocity of the separate disks) of 80 m./second. It is thought that with this high rate of speed a sharp heating up of the cut surfaces will occur. This idea is refuted, however, by investigations which were carried out at the Institut für Werkzeugmaschinen-Untersuchungen and by the skillful methods of Dr.-Ing. E. Sachsenberg of the Technische Hochschule at Dresden. MAB(12l)

Influence of Handling on Abrasive Performance. TORREY ALLEN. *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 769–770, 780.

Strength of the union that can be made between the abrasive and the glue depends upon the capillarity of the grains. Contamination by grease, moisture and dust lowers the capillarity value, thus decreasing the strength of the bond. Gives directions for applying abrasive to wheel. MS(12l)

Sand Blasting (12n)

Sand-Blast Abrasives. WILLIAM ASHCROFT. *Metallurgia*, Vol. 4, Aug. 1931, page 122.

Steel grit or shot has recently come into extensive use. The first cost of this material is higher than for sand, but the life is longer. Less dirt is formed with steel shot and the work has a cleaner surface. JLG(12n)

The Wear-Proof Sand Blast Nozzle. (Die verschleissfeste Sandstrahldüse.) U. LOHSE. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Aug. 29, 1931, pages 1107–1109.

After a short discussion of the action of a sand blast and costs for the compressed air, a new nozzle made by Badische Maschinenfabrik, Durlach, is described. This nozzle consists of several parts of steel, while the actual nozzle, through which the sand is blown, is made of tungsten carbide of a hardness 9.5–9.8. Comparison with an ordinary nozzle of a chill casting shows a life of 510 hrs. for the new against 4 hrs. of the old. Ha(12n)

Nozzle Dimensions and Most Advantageous Pressure of Sand Blast Blowers. (Düsenabmessungen und günstigster Arbeitsdruck von Sandstrahlgebläsen.) W. KAEMPFER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Aug. 14, 1931, pages 653–656.

A number of diagrams show the interrelation of work required, number of nozzles, form of nozzles, length of jet for the 3 systems of sand movement by exhaustion, gravity and pressure. No general conclusions are given; the selection depends too much on the individual case. Ha(12n)

FOUNDRY PRACTICES & APPLIANCES (22)

On Low Carbon and High Silicon Semi-Steels. Masayasu Horikiri. *Proceedings of the World Engineering Congress*, Tokyo, 1929, Vol. 34, *Mining & Metallurgy*, Part 2, page 125.

The relation between the physical and mechanical properties and the melting conditions of cast iron melted in a cupola were investigated. It was found that in cast iron melted at a low temperature or rapidly melted at a high temperature, graphite arises in large flakes even with rapid cooling. On the contrary, when melted at a high temperature or slowly melted, fine graphite appears even with slow cooling. From these results, the author concluded that graphitization takes place independently of the rate of cooling. So, in order to produce a cast iron with uniform and excellent mechanical properties, low carbon and high silicon contents are desirable.

From these results the author proposed a theory of graphitization in foundry work: In cupola operations, some atomic carbon or its nucleus exists in the equilibrium such as $Fe_3C \rightleftarrows C + 3Fe$ in the melt, its amount depending upon the conditions in the molten state. The graphitisation depends on the distribution of the graphite nucleus before solidification. That is, in low temperature or rapid melting, graphite arises in large flakes, since much nucleus is present, but semi-steel containing less carbon is produced in high temperature and hence the fine graphite arises.

The author determined the compositions of low carbon and high silicon semi-steels having excellent mechanical properties and uniform structure, as follows: Total C 2.5 to 2.8%, Si 3.0 to 2.0%, Mn 1.0 to 2.0%, P and S a trace Those of such compositions were named "H Semi-Steels" by him. TS(22)

The Diagnostician in the Foundry. **(Der Diagnostiker in der Giesserei.)** H. Hertlein. *Giesserei mit Die Giesserei-Zeitung*, Vol. 18, Sept. 4, 1931, pages 715–716.

For economy in the foundry, the use of a diagnostician is recommended. This is an apparatus for recording periods of operation of machines; in this case, for molding machines for quantity production. It is illustrated as used in a certain molding process. Ha(22)

Molding of Some Oval Shapes by Template. **(Schablonieren ovaler Formen.)** K. Hoffmann. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Sept. 4, 1931, pages 710–712.

The usefulness of the elliptic compass in molding oval shapes is noted and a construction is described. Ha(22)

Advantages and Inconveniences of Different Methods for the Production of Cast Steel. **(Avantages et inconvénients des différents procédés employés a la fabrication de l'acier dans les fonderies d'acier.)** J. Deschamps. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 763–765.

Very brief generalities. HWG(22)

Molding Sand Tests for Foundry Control. **(Application des essais de sable a la fonderie dans le but d'en assurer le contrôle.)** H. W. Dietert. *Congrès International des Mines ,de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 917–922.

American Foundrymen's Association exchange paper. Résumé of A.F.A. sand tests, their application and utility. HWG(22)

Present Methods of Test and Control of Molding Sand. **(Les méthodes actuelles d'essai et de contrôle des sables de moulage.)** A. Deleuse. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 923–930. 14 figures, 10 references.

A résumé, chiefly of information available in English. HWG(22)

Australian Steel-Foundry Practice. D. Clark. *Foundry Trade Journal*, Vol. 43, Aug. 28, 1930, pages 145–147, 149.

Historical remarks on the development of the steel industry in Australia are given first. The Bessemer process which was at first in use generally is being replaced by the electric furnace. The importance of pouring temperature, sources of molding sands and their properties, their influence on foundry practice are discussed with particular reference to Australian conditions. Ha(22)

The Fundamentals of Brass Foundry Practice. Part 27. R. R. Clarke. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, pages 384–385.

A description is given of the factors controlling melting and casting, an example being given of Cu : Sn : Zn : : 88 : 10 : 2. The methods of casting test bars, including "Government Bar" are included. PRK(22)

Some Practical Ideas on Drying. **(Quelques données pratiques sur l'étuvage.)** A. Debar. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 931–933.

Brief statement of principles of drying that might be applied in drying foundry molds and cores. HWG(22)

Calculations for Molding in the Foundry. Harry W. Dietert. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, pages 380–382.

Based upon results obtained from many years of experimental gating, etc., formula are given for calculating pouring time, effective sprue height, size of sprue, area of choke and thickness of gate. PRK(22)

Vibrating Molding Machines. **(Press-wende-Rüttelformaschine und Stiftabheberüttler.)** P. Nieth. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Aug. 28, 1931, pages 685–686.

A brief description of 2 types of molding machines one of which has found fairly wide use in America but is still new for Continental practice. Ha(22)

Casting Practice in the Dutch East Indies. **(Het Gieterijbedriif in Indië.)** B. F. Maalsté. *De Gieterij*, Vol. 5, July 1931, pages 87–88.

Description of the wax process as practiced up to the present day on the island of Java. HSvK(22)

Factors Influencing the Chilling Properties of Cast Iron. **(Les facteurs qui influencent les propriétés trempantes des fontes.)** A. L. Norbury. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 811–814. 5 figures.

General discussion of effect of superheating, repeated remelting and addition of steel, as means of dissolving the graphite, of effect of graphitizing elements and of rate of cooling. The article is less complete than other articles by Norbury that are in English. See also *Metals & Alloys*, Vol. 2, June 1931, page 122. HWG(22)

Effect of Excessive Atmospheric Moisture in Cupola Blast. Neil A. Moore. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Sept. 1931, pages 275–296.

The relation of O content of the iron to the moisture in the cupola blast is discussed. No data is given, though the author believes the fluidity of cast iron is influenced by the O content of the iron; and that excessive atmospheric moisture in the blast increases the tendency of the cast iron to chill. See also *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. CHL(22)

Iron and Steel Foundry Practice. Part VIII. Ben Shaw. *Metallurgia*, Vol. 4, Aug. 1931, pages 119–121.

Discussion of advantages and disadvantages of Bessemer, open-hearth and electric furnaces for making steel for casting. JLG(22)

Sands and Sand Testing. J. G. A. Skerl. *Foundry Trade Journal*, Vol. 45, July 23, 1931, pages 53–57, 58; Aug. 6, 1931, pages 86–90; *Metal Industry*, London, Vol. 38, June 26, 1931, pages 645–646.

A paper read before the Birmingham Convention of British Foundrymen, dealing with research work on raw molding sands typical of those in which 90% of iron and non-ferrous castings are made. A list of the experiments which have been carried out on each sand is given, as well as a description of methods and apparatus used for testing the mechanical constitution, strength, permeability and refractoriness of the sands. The author concludes: (1) Every sand has a definite moisture content at which it is strongest in the green-sand condition. This moisture content is not so great as that required to give the strongest sand after drying. (2) Molding sands are generally most permeable when they contain the moisture content at which they are strongest in the green condition. (3) Ramming increases strength and decreases permeability, while efficient milling increases strength but does not decrease permeability. (4) The permeability of a molding sand is largely governed by the silt content, the material coarser than the bonding material but less than the coarse sand grains. (5) The strength of a molding sand is increased about 20 times by drying. (6) The bonding material is the least refractory constituent of a molding sand, and, other things being equal, the greater the percentage of bonding material, the less refractory the sand. (7) Milling, among other considerations, improves the surface of castings. The paper is accompanied by 3 photographs and 3 diagrams. OWE(22)

The Brass Foundry in America. (La fonderie de laiton en Amerique.) W. Romanoff & C. O. Thieme. *Cuivre & Laiton*, Vol. 4, July 30, 1931, pages 332–334.

A general discussion of casting brass from new metals or from brass ingots. Tests of the mechanical properties did not show any deciding difference. This proved that the prejudice, frequently found against the ingot method, is not justified. Ha(22)

Method for Compacting Molding Sand in Molding Devices with Direct Action of Compressed Air on the Molding Materials. (Verfahren zum Verdichten von Formsand in Formeinrichtungen bei direkter Einwirkung von Pressluft auf die Formstoffe.) Friedr. Rolff. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Sept. 4, 1931, pages 712–714.

A few devices which constitute cheap and simple means for economical working are described. Core making and green core molding are especially considered. Ha(22)

Automatic Sand Plants. E. V. Ronceray. *Foundry Trade Journal*, Vol. 45, Aug. 27, 1931, pages 133–138.

A paper presented before the Lancashire branch of the Institute of British Foundrymen which deals with the problem of mechanizing foundries and the design of continuous-casting plants. The paper is accompanied by 17 illustrations of various devices which have been found of value in this connection and 3 diagrams showing the effects of milling on the different sand characteristics. Reference is made to various types of sand elevators, methods of preparing sand for the foundry, methods of removing sand from the storage bins, and arrangements for reconditioning sand for use in the foundry. A description is given of hopper- and conveyor-delivery systems. Space is devoted to the discussion of the paper. OWE(22)

Nickel Cast Iron. (Fontes au nickel, études et applications récentes.) F. Renaud. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 819–830. 9 figures; *Metallbörse*, Vol. 20, Aug. 23, 1930, page 1884.

A résumé. The information contained is taken largely from other publications especially those in English by Coyle, and from French publications by Ballay and others. HWG+WHB(22)

High Grade Light Metal Castings from Secondary or Virgin Metal? (Hochwertiger Leichtmetallguss aus Alt-oder Neumetall?) H. Röhrig. *Metallwirtschaft*, Vol. 10, July 17, 1931, pages 581–582; *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 295–298.

Three lots of Al alloy remelt purchased from a first class dealer were analyzed and 3 lots of alloy were made up of virgin metals, containing the same percentage of Cu and Zn as the remelts, but less Si, Fe and other impurities. The 6 lots were cast into test bars in sand and chill molds. The yield point and Brinell hardness were almost the same, the tensile strength and elongation of the virgin metals were slightly better, and the impact strength and endurance limit were much better. Reasons given are the porosity of the remelt heats, the presence of the brittle, needle shaped constituent Al_3Fe and of oxides and nitrides, and a generally less uniform product. In spite of the improvement in the secondary metal situation, virgin metal should be used where high dynamic stresses are encountered CEM+Ha(22)

Contributions to the Knowledge of the Shaking Process. (Beitrage zur Kenntnis des Rüttelvorganges.) A. Rodeheuser & R. Walle. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 24, 1931, pages 593–596.

The conditions for compressing and tightening the sand in the mold are discussed and tests in the laboratory are described. These tests to elucidate the process were made under conditions closely approaching conditions in the foundry. Ha(22)

The Utilization of Brass Sheet-Cuttings and Chippings in the Foundry. (Die Verwertung von Messingblechabschnitten und -spähnen in der Giesserei.) E. T. Richards. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 10, 1931, pages 558–561.

The present great competition compels the utilization of a certain amount of scrap together with new metal. Considering that the brasses which are used commercially are usually standardized, the use of sheet cuttings is especially recommended as most economical. The preparation of the scrap for the foundry, drying, freeing of oil, briquetting, etc., is discussed. This preparation depends, to a certain extent, on the kind of furnace used for melting. Ha(22)

The Suitability of Different Oils as Core-Binding Material. (Ueber die Eignung verschiedener Oele als Kernbindemittel.) H. Nipper & K. Krekeler. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 1, 1931, pages 353–357.

Tests are described to determine the permeability, strength, structure of oil-sand cores as a function of the addition of oil, duration of baking and baking temperature and of humidity, and the influence which these factors have on the quality of the casting and its surface. Six different binding oils were used. Raw linseed oil has proved to be better than other binders recently developed. Ha(22)

Respiratory Protection in Foundries. (Atemschutz in Giesserein.) O. Neuss. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 29, 1931, page 442.

A few protective devices (masks) against carbon monoxide, Pb and Zn vapors are described. Ha(22)

FURNACES & FUELS (23)

Investigations of the Combustion in Industrial Furnaces. **(Untersuchungen zur Kenntnis der Verbrennungs vorgänge in technischen Gasfeuerungen.)** R. Pistor. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 565–577.

Report 151 of the Committee on Heat of the Verein deutscher Eisenhüttenleute. Includes discussion. In burning coke oven gas with deficient air supply, the composition of the unburnt waste gases varies with the amount of air deficiency. With deficient air supply, the H content of the waste gases surpasses that of the coke oven gas, but decreases with increasing air. The content of CO reaches a maximum at half the theoretical air volume. The amount of H of the flame and of the waste gases is practically the same. The intimate mixture of gas and air and the air volume determine the length of the flame. A formula is developed to calculate the theoretical combustion temperature. GN(23)

Powdered Coal in Steel Forging Plants. Wm. Clifford Rehfuss. *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1447–1449, 1451.

A general discussion of powdered coal systems and the burning arrangements in furnaces. A particular example is described. Ha(23)

The Gas Producer. III. Conduction of Gas Producers Fuel Tests. John W. Romig. *American Gas Journal*, Vol. 134, Jan. 1931, pages 54–55.

Describes the Orsat apparatus and tells how the following solutions are made for the apparatus: ammoniacal cuprous chloride solution, potassium hydrate solution, potassium pyrogallate solution, waste gas and producer gas. MAB(23)

Industrial Electric Heating. XVI. Heating and Cooling of Metals. N. R. Stansel (General Electric Co.) & S. L. Hoyt (A. O. Smith Corp.). *General Electric Review*, Vol. 34, Oct. 1931, pages 573–579.

This installment deals with the basic property of allotropic transformation in consideration of the relations of the engineering properties of metals. When a C-steel is heated through its critical range, 2 changes taking place are: (1) the body-centered cubic lattice is transformed and (2) C forms a solid solution (austenite) with γ iron by inclusion of the C in the space lattice of the γ iron crystalline structure. 3 purposes of such heating are: (a) strain relief, (b) diffusion of the C through the mass of the metal, and (c) recrystallation, i. e., grain refinement. The cooling of C-, eutectoid- and hypereutectoid steels is discussed. Numerous curves and photomicrographs are shown. WHB(23)

Powdered Coal in German Malleable Foundries. **(L'emploi du charbon pulvérisé dans les fonderies Allemandes de malléable.)** R. Stotz. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 889–902. 32 figures.

The Brackelsberg rotating, and the Wirges oscillating furnaces are described and illustrated, as are reverberatory type furnaces, all fired with powdered coal. Annealing furnaces similarly fired are also described. The pulverizing equipment and the burners are shown. Considerable economic advantage is claimed for all these. Use of the Brackelsberg furnace is increasing. It gives malleable averaging 63,000 lbs./in.^{2} tensile strength, 19% elongation in $2^1/_2$ in. HWG(23)

Water Cooled Skids in Rolling Mill Furnaces. **(Wassergekühlte Gleitschienen und Stützen in Stossögen.)** A. Sprenger. *Stahl und Eisen*, Vol. 51, July 30, 1931, pages 961–965.

The article describes new constructions and arrangements of water cooled skids of rolling mill furnaces that offer remarkable advantages in comparison with previous types of water cooled skids. GN(23)

Electric Annealing Furnaces in the Metal-Working Industries. **(Elektrische Glühöfen in der metallverarbeitenden Industrie.)** Alf. Schau. *Siemens-Zeitschrift*, Vol. 11, Apr. 1931, pages 209–218.

The advantages of electrically (resistance) heated annealing furnaces, as shown by several examples, are discussed. The principal requirement of a furnace is that it must be so constructed, charged or controlled that in all sections of the furnace the difference between heat supplied, and externally and internally absorbed, is as equal as possible. If this condition is fulfilled, electric heating facilitates greater uniformity of temperature than any other heating method. Examples given are a soaking pit for ingots up to 20 t. heated by a 3-phase 500 volt current, 350 K.W consumption; several furnaces for small parts, 1000° C., 250 to 350 K.Wh/t. consumption; for refining of steel, wheel tires for railroad cars, annealing of sheets, 140 K.W; hardening furnace for sickles, 800° to 900° C., 70 K.W; bare annealing of copper wire with water vapor as protective atmosphere, daily output of 15 to 20 t. of wire, 60 K.W. Ha(23)

Modern Gas Producer Practice. F. Johnstone Taylor. *Iron & Steel Industry & British Foundryman*, Vol. 4, Mar. 1931, pages 191–193; Apr. 1931, pages 239–244; June 1931, pages 302–304; July 1931, pages 339–342; Aug. 1931, pages 371–374; Sept. 1931, pages 405–406, 409.

A comprehensive survey of the present position in regard to gas producer practice. The characteristics of various types of producers and accessory equipment are described in detail. The uses and production of producer gas are dealt with briefly. CHL(23)

Heat Balance for Rotary Forging Furnaces. Theo. F. Schilling. *Heat Treating & Forging*, Vol. 16, Oct. 1930, pages 1317–1318, 1321; Nov. 1930, pages 1452–1454.

See *Metals & Alloys*, Vol. 2, Feb. 1931, page 49. Ha(23)

Annealing Copper and Its Alloys in Electric Furnaces. **(Elektrisches Glühen von Kupfer und seinen Legierungen.)** E. Fr. Russ. *Metallwirtschaft*, Vol. 10, June 19, 1931, pages 495–500; June 26, 1931, pages 513–518.

The comparative efficiency of coke, gas and electric furnaces is compared. A table shows the K.W. hours required to heat various metals to various temperatures. Heating units of Cr-Ni-Fe alloys are used in electric furnaces. Their advantages include absence of products of combustion, almost neutral atmosphere, easy temperature control and uniform heating. They can be placed in the shop wherever needed. Different types are (1) Muffle furnaces, for sheets, wire and billets. There is a loss of heat at the door in this type. (2) Long annealing furnaces, for bars, tubes and shapes loaded on buggies. (3) Continuous billet furnaces for bolts and billets of brass, Cu and nickel silver, with horizontal or inclined bottoms. The charge is pushed through by hand. Side doors are sometimes used to prevent heat loss. (4) Conveyor furnaces, for coiled strip. Good heat control resulting in close control of hardness and grain size is obtained in this type and the operating cost is low. Examples including dimensions and construction details and current consumption are given. A strip annealing furnace can be combined with a quenching tank, acid dip, rinsing tank, drying oven and coiling device, all using the same continuous conveyor. (5) Rotary furnaces, for small parts, consisting of a drum rotating on rollers or a circular furnace, the hearth of which rotates on rollers. (6) Bright annealing furnaces, air tight pot furnaces with a double top for a seal. The air in the pot is displaced by a neutral gas to prevent oxidation of the charge and the charge must be left in the furnace after annealing until cool. Large charges are desirable. CEM(23)

The Design and Operation of Open-Hearth Furnaces. Part II. C. W. Veach (The Bettendorf Co.). *Rolling Mill Journal*, Vol. 5, Feb. 1930, pages 91–94, 106.

Describes design and construction of the various parts of the open-hearth furnace and discusses the engineering principles concerned in the design of foundations, insulation, walls and roof with methods for meeting exacting conditions of service. JN(23)

Development of Steel Mill Furnaces with Remote Gas Supply. **(Entwicklung der Feuerungen in Eisenwerken unter den Einfluss der Ferngasversorgung.)** P. Rheinländer. *Archiv für Eisenhüttenwesen*, Vol. 4, May 1931, pages 513–531; *Stahl und Eisen*, Vol. 51, June 18, 1931, pages 767–769.

Report No. 150 of the Wärmestelle of the Verein deutscher Eisenhüttenleute. Construction, capacity and operation of a great variety of steel mill furnaces with remote gas supply are described; the results of tests are tabulated. It must be decided, in every individual case, if the rebuilding of furnaces for remote gas supply or the new construction of furnaces with remote gas supply is economical. The introduction of gas in forging plants offers great advantages for heat efficiency, since the use of gas is especially applicable to furnaces with high temperatures. Due consideration must be given in this case to the scaling proposition. The increased scaling in gas fired forging furnaces retarded the introduction of such furnaces. It can, however, be stated that proper design and control of such furnaces keeps the scaling within reasonable limits. The type of scale varies with the furnace atmosphere, whether ordinary or reducing. A neutral or slightly oxidizing atmosphere seems to be more favorable. In introducing gas heating in annealing furnaces, the temperature control is of particular importance. Three different types of temperature controllers are described. The largest part of the paper deals with the efficiency of heating with coal gas supply. Though it is found in comparing the cost of the heat unit of various fuels, that the cost of coke oven gas is relatively high, it shows the lowest heat loss by waste gases. Under certain conditions of fuel price, heat value and air excess, diagrams of degree of efficiency, cost of heat unit and quantity of fuel are designated per 1 m.^{3} of dried gas. The following table shows the difference of efficiency:

Type of fuel	Lower heat value kg./cal.	Air excess	Efficiency
Coke oven gas	4000 kgcal./m.^{3}	10%	53%
Oil	9500 kgcal./kg.	20%	53%
Producer gas	1300 kgcal./m.^{3}	10%	42%
Coal	7000 kgcal./kg.	70%	34%

In comparing the cost of 1000 heat units utilised in the furnace, the heat in coke oven gas is more expensive at low temperatures than in the case of coal or producer gas. At high temperatures, the economy is reversed. The higher capacity per unit of area and the easier control of the gas fired furnace offers a further saving of heat. Furthermore, the advantages of operation of gas fired furnaces are pointed out. Numerous calculations of economy for various mill furnaces are included in the paper. GN(23)

Principles and Some Practical Applications of Electric Furnaces with Atmospheric Control. A. N. Otis (General Electric Co.). *Iron & Steel Engineer*, Vol. 8, Aug. 1931, pages 352–359.

Includes discussion. Methods of obtaining low cost H for furnace atmospheres are discussed. If comparatively large amounts are wanted, the "Electrolene" producer offers the cheapest means of obtaining a gas high in H content. Electrolene consists of about 75% H_2 and 20% CO and is obtained by cracking any available hydrocarbon gas in the presence of steam. Dissociated ammonia is also a convenient and relatively inexpensive source of H. For bright annealing, the gases used must be purified from all traces of O, water vapor and S. Several types of hood, pit, tunnel and elevator furnaces for bright annealing and copper brasing are illustrated and discussed. Considerable saving in time and cost of heating are realized with electric furnaces for strip annealing as compared with the old methods. WHK(23)

Soaking Pits Operate without Checkers. J. B. Nealey. *Steel*, Vol. 89, Aug. 27, 1931, pages 31–32.

Describes a new type of soaking pit in which the checkers have been replaced by refractory tile recuperators or metallic air preheaters. The intermittent reversal of firing and draft has been supplanted by the one-way system in which the gases are fired continuously through a port at the top of the pit and taken out continuously at the bottom of the pit in the same wall with the firing port. Gas is used as fuel and hot air from the recuperator is supplied to the burner. The temperature of the soaking pit is maintained at from 2300° to 2400° F. by the waste gases which leave the pit at about 2200° F. Ha(23)

A Study of the Influence of Certain Physical and Chemical Factors on the Operation of the Blast Furnace. **(Étude de l'Influence de Certains Facteurs Physiques et Chimique sur la March des Hauts Fourneaux.)** Armand Peters. *Chimie et Industrie*, Vol. 25, June 1931, pages 1327–1338.

The author shows how the consumption of coke may be decreased by increasing the indirect reduction. The action of the gas from the blast furnace on the oxides of Fe is discussed, as well as the agents which favor indirect reduction, the combustion which takes place in the crucible, and the amount of coke used (in lbs.). MAB(23)

The Propagation of Combustion in Powdered Coal. H. E. Newall & F. S. Sinnatt. *Great Britain Safety in Mines Research Board Paper* No. 63, 1930, 58 pages.

The influence of preoxidation of the coal on the time of propagation was examined by heating the coal for certain periods of time in air at the temperatures of 100°, 150° and 200° C. This treatment caused an increase in the time required for the zone of combustion to travel through a definite length of a train of the dust. The increase in time was marked in the early stages of oxidation. Finally a state of oxidation was reached when the combustion could no longer be initiated in the coal. Different coals showed marked differences as regards the increase in time and in the duration of oxidation required to bring about cessation of propagation. The effect on preheating the coal in nitrogen has been studied and it was found that preheating at temperatures from 100° to 300° C. increases the time of propagation. From 300° to 400° C., the time decreases initially, but prolonged heating in N causes an increase in the time of combustion. An increase in the O percentage above that of normal air decreased the time, and a reduction of the O percentage caused an increase in the time of propagation. There was, however, no exact relationship between the O content and the rate of combustion. The lowest percentage of O in the atmosphere in which the coal would burn varied with different coals, but the minimum recorded was 14.0%. The addition of small amounts of inorganic substances in the majority of cases decreased the time of propagation. Potassium and sodium salts, particularly the hydroxides, were effective in decreasing the time, the carbonates and iron salts acted in a lesser degree. Ammonium chloride and hydrochloric and sulphuric acids increased the time of propagation. It was observed that hydrogen cyanide was one of the gaseous products of combustion and a brief study was made of the conditions under which it is produced during the propagation of a zone of combustion. The temperature attained in the center of a cone of coal during combustion was controlled by varing the rate of excess air to the coal and the amount of hydrogen cyanide produced at various temperatures was determined. The maximum amount which could be obtained was 0.1% by weight of the coal. No hydrogen cyanide was found at temperatures lower than 300° C., and in certain coals only a trace was present when temperatures of 450° to 480° C. were reached. The experiments show that the composition of the oxidation product produced from any coal is constant and independent of the rate of propagation of the zone of combustion through the coal. WAT(23)

REFRACTORIES & FURNACE MATERIALS (24)

The Passage of Gas Through the Walls of Pyrometer Protection Tubes at High Temperatures. WM. F. ROESER. *Bureau of Standards Journal of Research*, Vol. 7, Sept. 1931, pages 485–494; *Bureau of Standards Research Paper* No. 354.

The results of the measurements of the rate of passage of air through 36 tubes of refractory porcelain, both glazed and unglazed, (11 different classes) 2 of fused silica, 1 of pyrex glass, 2 of alundum and 15 of metal are given for various temperatures which the tubes would withstand without noticeable deformation. The tests indicate that the very refractory porcelain tubes (often referred to as sillimanite or mullite) are decidedly superior to the older porcelain tubes, both in refractoriness and gas tightness. The results indicate that tubes of calorized wrought iron are more gas tight than those of other metals at the higher temperatures. Nickel-chromium tubes, in general, were more gas tight than those of other alloys. The tests also showed that it was possible to maintain pressures of less than 0.001 mm. of Hg in a refractory porcelain tube at 1400° C. by the use of an ordinary laboratory type mercury vapor pump. Methods of testing are described and a very brief discussion given of the processes by which air may pass through the tube walls. No attempt has been made to correlate the data reported in this paper with data obtained by other observers, since measurements have not been made under similar conditions. Most of the data reported have been on the passage of gases through glass, silica and metals. No data have been found on the passage of air through solids or on the passages of gases through porcelain. WAT(24)

Some of the Newer Uses for Silicon Carbide. CHARLES MCMULLEN. *Metal Industry*, London, Vol. 39, July 10, 1931, pages 35–36.

Besides being used as an abrasive, silicon carbide finds use as a refractory and as resistance for heating elements in electric furnaces and therapeutic lamps, resistance in radio circuits and even as lightning arrestor for it becomes a conductor at high voltages. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 152. PRK(24)

Recuperator Theory. (Contribution a la théorie des récupérateurs alternatifs.) L. THIBAUDIER. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 73–86.

Mathematical. Includes discussion. HWG(24)

The Behavior of Refractory Linings in Furnaces of the Iron and Metal Foundry. (Ueber das Verhalten feuerfester Ausmauerungen in Oefen der Eisen- und Metallgiesserei.) F. NIEBLING. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Feb. 13, 1931, pages 144–146.

A discussion of the properties of a refractory material shows that the suitability of a brick cannot be judged on the basis of any one individual test. The mutual relations between change of temperature and attack of slag, and between high temperatures and temperature change are of much greater importance. These relations cannot easily be determined by a single test. Many failures can be traced to insufficient consideration of these relations. Ha(24)

The Possibility of Andalusite as a Refractory. FRANK H. RIDDLE. *Metal Industry*, London, Vol. 38, June 5, 1931, pages 571–572.

Paper presented before the Electrochemical Society at Birmingham, Ala., Apr. 1931. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 190. PRK(24)

Sillimanite Minerals as Refractories. F. H. RIDDLE. *Brick & Clay Record*, Vol. 79, Aug. 11, 1931, pages 130, 132, 134, 138.

This paper gives a review of the recent development of natural and synthetic refractories and the tests made with them. The natural deposits, process of preparation, bonding materials and tests made are described. Seven references are cited. Ha(24)

Refractories and Their Uses. P. F. THOMPSON (University of Melbourne). *Chemical Engineering & Mining Review*, Vol. 23, Sept. 5, 1931, pages 455–459.

An abstract. Refractories are discussed from the standpoints of: changes undergone during heating alone, reactions between grains and bond during heating, changes on cooling, reactions with substances being treated and testing of them. WHB(24)

Electric Furnace Production of High-Heat-Duty Refractories. FRED W. SCHROEDER (Corhart Refractories Company). *Industrial & Engineering Chemistry*, Vol. 23, Feb. 1931, pages 124–126.

Herein are described the making of molds, preparation of the batch, melting, casting and annealing, properties and uses of refractories. Blocks as large as 18 × 18 × 48 ins. can be cast satisfactorily. Electric furnace refractories find application also in metallurgical equipment such as forging furnaces. MEH(24)

GASES IN METALS (25)

Melting and Solidification Points of Silver Copper Alloys Containing Oxygen. (Über Schmelz- und Erstarrungs-vorgänge sauerstoffhaltiger Silber-Kupferlegierungen.) H. MOSER & K. W. FRÖHLICH. *Metallwirtschaft*, Vol. 10, July 3, 1931, pages 533–535.

Contains 8 references. Ag-Cu alloys used for silverware easily absorb O with the formation of Cu_2O when molten which is objectionable in later rolling, forging and polishing operations. The system Ag-Cu-Cu_2O was investigated thermally and microscopically. The alloys were melted under N in hard porcelain crucibles and heated to 1240° to insure equilibrium. Preliminary tests showed that Cu_2O was soluble in a 1:1 Ag-Cu alloy at its melting point up to at least 27%. With 1% Cu_2O the melting point of Ag-Cu alloys is raised. The maximum increase is 43–48° at 80% Ag, 850° against 802–807°. Ag, Cu and Cu_2O each form a binary eutectic with the other. The ternary eutectic was found to contain 0.7–0.8% Cu_2O, 66.5% Ag and 32.8% Cu with a melting point of 776°. The binary eutectic contains 71.6% Ag and 28.4% Cu and melts at 779°. If a small amount of Cu_2O is added to this binary eutectic considerable quantities of primary Ag separate on cooling. If Cu_2O in the ternary eutectic is replaced by Cu, Cu separates. This is illustrated with photomicrographs and cooling curves. In the eutectic Cu_2O is present in the form of small rounded granules, but if an excess is present it segregates into long dendrites. CEM(25)

Gray Iron and Other Metals Are Affected by Gas. E. PIWOWARSKY. *Foundry*, Vol. 59, Aug. 15, 1931, pages 48–50, 53–54.

Metals and alloys take up certain gases in liquid and also in solid states. According to Sieverts, the solubility, m, of H in Fe in relation to pressure (p in atmospheres) by the constant temperature, the relationship: $m = c\sqrt{p}$ where c is a constant. Hydrides of Fe have not been confirmed metallographically but nitrides of Fe and accompanying elements have been observed many times. O is present in liquid Fe often as FeO or combined with other elements found with Fe. CO and CO_2, which escape during solidification and which are the cause of porosity and blow-holes, owe their origin to reaction between the metallic oxides present and the C. Deoxidation with C in vacuum leads to complete removal of O. Complete deoxidation is not possible as long as slag exhibits free and dissolved oxides. Cast Fe melted hot always requires end treatment with Si, Al, Ti or V to obtain dense castings free from blow-holes. Contains several graphs and tables. VSP(25)

The Influence of Oxygen on the Working of Technical Silver Copper Alloys. (Der Einfluss des Sauerstoffs auf die Verarbeitbarkeit der technischen Silber-Kupfer-Legierungen.) E. RAUB. *Metallwirtschaft*, Vol. 10, Oct. 2, 1931, pages 769–773.

Seven references. Cu_2O is detrimental to Ag-Cu alloys because it coalesces readily and is very hard and brittle. The hardness makes working more difficult as Cu_2O will not flow. During forging the cast bars are brittle and crack if they contain Cu_2O, which sometimes forms dendrites. During rolling, sheets are apt to crack on the surface. Microscopic examination of such cases nearly always disclose large Cu_2O inclusions adjacent to the cracks and often also finely divided CuO. Even the 80% Ag alloy will be covered with a thin oxide coating if annealed in air. If this coating is not removed by an acid dip it is rolled into the soft metal where it coalesces into larger particles, which may cause a spalling off at the surface. It the annealing and rolling process is repeated, several layers of Cu_2O may form on top of each other. Surface irregularities after the polishing are caused by Cu_2O inclusions near the surface on account of their higher hardness. They also prevent uniform electroplating. Porous spots form over the oxides which retain a trace of the plating solution and later corrode. O may be introduced into the alloy at various stages. Some is contained in the original Cu used, especially if it is in the form of shot or granulated. Much of the raw material is scrap. In England and the U. S., Cd is used as a deoxidizer during the melting; in Germany, 10% phosphor Cu. Phosphor Cu reacts more intensively than Cd but causes defective silver plating if used in excess. Addition of 0.05% to secondary material is sufficient. Various fluxes or charcoal are used for protection against air during melting. During casting a reducing atmosphere can be produced around the metal stream by a piece of burning wood. To prevent absorption of O during annealing, the alloy can be annealed in H or illuminating gas, but only if it is free from oxide to start with; otherwise steam pockets will be formed by the reducing action of H. After annealing, surface oxidation should be removed by an acid dip. CEM(25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Iron Reduces Crystal Size in Aluminum Bronze. CHARLES VICKERS. *Foundry*, Vol. 59, May 1, 1931, pages 55–57.

Al bronze differs from other metals having large crystals in that it is not weak and easily broken. Temperature will weaken bond between these crystals and when proper degree is reached they will drop apart. Bronze cylinder 8 in. high, 6 in. in diameter having risers of same weight cast in sand showed Brinell hardness of 94. It contained 10.03% Al, 0.007% Ca and the rest Cu. Physical properties ranged from 50,000 to 65,000 lbs./in.^{2} with elongation of 7 to 20%. Considers self annealing. Discusses experiments of Portevin and Amon on heat treatment of Al bronze. Quenching from 1652° F. and reheating around 1260° F. increases tensile strength. Presence of Al with Cu and Fe will insure a perfect triple alloy. Tabulates results. VSP(27)

The Influence of Alloy Elements on the Iron Carbide of Cast Iron. (Der Einfluss der Legierungselemente auf das Eisenkarbid des Gusseisens.) FRANZ ROLL. *Giesserei*, Vol. 16, Oct. 4, 1929, pages 933–936.

A recent contribution to the literature of alloy cast iron approaches the subject from the purely theoretical standpoint and deals with the influence of the various alloy constituents as related to the position of these elements in the periodic system. The groups of the system are individually considered and the influence which the respective elements may be expected to exert on the carbide constituent of the iron is discussed. (27)

The Influence of the Elements Silicon, Phosphorus, Aluminum, Nickel and Chromium on the Quasi-Isotropy and the Wall Thickness Sensitivity of Cast Iron. (Ueber den Einfluss der Elemente Silizium, Phosphor, Aluminium, Nickel und Chrom auf die Quasiisotropie und die Wandstärkenempfindlichkeit von Gusseisen.) E. PIWOWARSKY & E. SOEHNCHEN. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 3, 1931, pages 533–537.

The crystalline state is characterized by its anisotropic character; that is, the properties of the crystals are different in different directions. The individual crystals making up a material are so numerous that the single crystal is very small in relation to the wall thickness and the body will, therefore, behave like an isotropic body. This shows the same properties in all directions because the properties of the single crystal are of no import. This state is designated as quasi-isotropy. The quasi-isotropy is the necessary condition for the mechanical uniformity of a body. The thickness plays, therefore, a very important part and the present investigation shows that Si and P deteriorate the quasi-isotropy and wall thickness sensitivity considerably. Al has the same effect, although milder. Ni acts very favorably on both factors and Cr has no marked influence. The respective tests are reproduced in full and 13 references are cited. Ha(27)

Some Effects of Nickel on Bronze Foundry Mixtures. N. B. PILLING & T. E. KIHLGREN. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, July 1931, pages 93–114.

Foundry bronze mixtures as modified by contents of Ni up to 3% are discussed. Small amounts of Ni were found to be favorable. The best Ni content differs considerably depending upon the nature of the base mixture. CHL(27)

Factors Influencing the Hardness of Cast Iron. (Ueber die Faktoren die Härteeigenschaften des Gusseisens beeinflussen.) A. L. NORBURY. *Metallbörse*, Vol. 20, Aug. 30, 1930, pages 1939–1940.

The influence of various factors upon the precipitation of fine graphite particles in the molten Fe is discussed. The addition of graphitizing substances probably causes the precipitation of a large number of finely divided graphite particles which are dissolved easier and quicker than the big flakes. Gray castings made with the addition of such graphitizing substances show better strength values. Fe-Si, Ca-Si or Ni additions have this effect. Mn and S by themselves favor the tendency toward hardening. Always being present at the same time, however, they neutralize each other through the formation of MnS. In order to neutralize the effect of S, an excess of 0.3% Mn over the quantity theoretically required for the formation of MnS, is necessary. P seems to diminish the tendency toward hardening of thin pieces cast in sand molds. The tendency toward hardening is diminished by Al, Ni, Cu and Co, while it is increased by V, Cr, Si, Mo, Sn, Sb and W. WHB(27)

Vanadium in Metallurgy. (Le Vanadium en sidérugie.) N. PETINOT. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 103–115.

General discussion of vanadium steels. In discussion, Houdremont gives a table showing the benefit of high quenching temperature in the heat-treatment of vanadium steels as far as tensile strength goes, but with loss of impact resistance. He states that except in high speed steel and as a deoxidizer, other elements, especially Mo, nowadays replace V. He particularly mentions high-temperature service. Petinot replied that the V steels cited by Houdremont with 0.05 and 0.45% V were not representative of normal V steels and gives a table showing high impact after a high-temperature quench and a draw of a 0.15% V, CrV steel, also one showing only slightly greater ductility for Cr-Mo than for Cr-V steel heat-treated to the same tensile strength. HWG(27)

Steels Made without Manganese. S. B. Ritchie. *Metal Progress*, Vol. 20, Sept. 1931, pages 35–39, 118.

A paper presented before the Boston Convention of the American Society for Steel Treating, Sept. 1931 and to be published later in greater detail and with discussion in the Transactions. The strategic character of Mn as a material not produced in this country has encouraged the Ordnance Department to make studies of steel produced without Mn. Melts are described using Zr instead of Mn as a deoxidizer. The melting was done in a high frequency induction furnace and all the charge with half of the Zr was added at the start. The charge consisted of an Armco iron base to eliminate the introduction of Mn. The other half of the Zr was added 10 minutes before tapping. Steel made was a forging grade of V-Mo steel. Macro-etched sections of ingots, forgings and centrifugal castings made from these heats are shown. The study of the heat treatment and physical properties of the steel without Mn shows it to be equal in quality and properties with alloy steels of the same alloy content with normal Mn. WLC(27)

INSTRUMENTS & CONTROLLERS (28)

A New Temperature-Time Regulator. (Ein neuer Temperatur-Zeit-Regler.) G. Gerold. *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 650–651.

Brief description and practical results of a new Siemens & Halske temperature controller which is distinguished by its strictly automatic control. Any desired temperature-time course can be obtained. GN(28)

Automatic Controls in the Chemical Industry. W. N. Greer. *Canadian Chemistry & Metallurgy*, Vol. 15, Sept. 1931, pages 239–240, 245.

Electrolytic conductivity and H-ion concentration are finding increasing usage in the chemical industry for automatic control. Applications in the control of pickling baths, and of black liquor diffuser washings are discussed. In pickling baths, a conductivity measurement alone cannot be used for automatically controlling the acid concentration. If the bath is made continuous by overflow with continuous addition of water and the H_2SO_4 addition controlled, the problem is simplified. The bridge circuit employed for the measurement of and contacts for actuating the control are illustrated. In automatic H-ion concentration control, a quinhydrone-calomel electrode designed for continuous measurements is used as the detecting unit. An electrode is illustrated, applicable where 100 cc./min. continuous sample of solution is available and the pH range is 1–9, the temperature range 5–40° C., and the solution practically free from oxidizing or reducing substances and suspended materials. WHB(28)

Air-Flow Gauge and Calculator. A. Baumann. *Brown Boveri Review*, Vol. 18, Feb. 1931, pages 109–110.

The apparatus described is used to calculate the flow of steam and compressed air produced in electrical energy, gas and water plants. The air meter, for a blast furnace blower records the weight of dry air independently of the air pressure, temperature or humidity. MAB(28)

Practical Evaluation of the Calibration Curves for Thermo-elements. (Praktische Auswertung von Eichkurven für Thermoelemente.) W. Koch. *Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 2, Aug. 1931, pages 302–304.

Explains a simple and accurate method for determining calibration curves thermoelements. The accuracy of the method is considered. MAB(28)

The Capacities of Emission of Liquid Iron Alloys. (Die Emissionsvermögen von flüssigen Eisenlegierungen.) G. Naeser. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 12, No. 23, 1930, *Report* No. 168, pages 365–372; *Stahl und Eisen*, Vol. 51, Mar. 5, 1931, page 304.

The coefficients of emission of liquid iron alloys were determined between 1350° and 1550° C. Beside the red color generally used, measurements were also taken in yellow and green in order to find out the color that has the smallest deviation from the true temperature. The measurements were taken in a high frequency furnace. The C content does not affect the coefficients of emission. The deviations from the true temperatures are smaller in the green than in the red. The results of the measurements in red are in satisfactory accord with previous investigations. GN(28)

Dust-Concentration Meter for Blast-Furnace Gas. A. W. Simon. *Iron & Coal Trade Review*, Vol. 122, Jan. 2, 1931, page 7.

The construction of an instantaneous and recording dust-concentration meter, a so-called kapnograph, is described which is based on the principle that the amount of light absorbed and, therefore, transmitted by a column of dust-laden gas depended on the dust content of the gas. The light of a lamp is concentrated and sent through the column and thrown onto a light sensitive thermopile which is connected to a recording meter. Ha(28)

Remote Measuring in Steel Mills. Part I. The Principles of the Methods of Remote Measuring. (Fernmessen auf Eisenhüttenwerken. I. Die Grundzüge der Fernmessverfahren.) B. von Sothen. *Archiv für Eisenhüttenwesen*, Vol. 5, July 1931, pages 17–28.

The paper deals with the principles and methods of remote measuring devices for the manifold applications in steel mills. GN(28)

On a Comparameter for Determination of Thermal Expansion of Solid Bodies up to 1400° C. (Ueber einen Komparator für Ausdehnungsmessungen fester Körper bis zu 1400° C.) W. M. Cohn. *Zeitschrift für Instrumentenkunde*, Vol. 50, Mar. 1930, pages 198–204, 10 ref.

After characterizing the former comparators of the Physikalisch-Technische Reichsanstalt and of the Bureau of Standards, the author introduces the new instrument by which determination as high as 1400° C. can be achieved. EF(28)

Instruments and Measurements. Annual Report of Committee on Instruments and Measurements. E. J. Rutan, *et al.* *Electrical Engineering*, Vol. 50, July 1931, pages 587–589.

Activity has been shown by the Committee on standard definition for telemetering, standards for recording and indicating instruments, a revision of Standards No. 14—instrument transformers, a revision of electric units, a symposium on precision measurements, technique of temperature measurements, measurement of reactive power, and a method of measuring distortion factor. WHB(28)

Calibration of Beckmann Thermometer. I. Corrected Eucken's Method. Mototaro Matsui, Shuu Kambara, Katsuji Miyamura & Akira Miyoshi. **II. Precise Calibration of Graduation Scale.** Mototaro Matsui & Katsuji Miyamura. *Journal Society of Chemical Industry*, Japan, Vol. 34, June 1931, pages 197B–202B.

The corrections and improvements to Eucken's method of the operation of the calibrations were made on the following two Beckmann thermometers: (1) Jena glass 16III Rober Carl No. 19510, P.T.R. No. 100862 certified in 1923, (2) Jena glass 16III V. F. L. Berlin No. 99,832. Part 2. Precise calibration of graduation scales was performed on the same instruments as used in Part I. The Gay-Lussac method and the Neumann-Theisen method were used. A correction table of graduation scale is given. MAB(28)

Some Sources of Errors in Thermo-Electric Measurements. (Einige Fehlerquellen bei thermo-elektrischen Messungen). O. Walger & F. R. Lorenz. *Zeitschrift für technische Physik*, Vol. 11, July 1930, pages 242–246.

The paper pertains to the influence of the microstructure of lead wires upon the accuracy of thermo-electric measurements. EF(28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing under this heading are prepared in coöperation with the Joint High Temperature Committee of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Piping for 1000-Degree Steam. J. H. Walker. *Heating, Piping & Air Conditioning*, Vol. 3, Apr. 1931, pages 283–287; *Power Plant Engineering*, Vol. 35, June 1, 1931, pages 606–608.

Short time tensile strength-temperature chart to temperatures of 1800° F. giving values on a Ni-Cr cast steel (1.8 Ni, 0.7 Cr), 0.44% C cast steel, and C seamless steel pipe is presented. Creep-stress-temperature chart to temperatures of 1600° F. give life on bases of 1% creep in 100,000 hours on 18% Cr 8% Ni steel and a 0.45% C steel. A general discussion on pipe design and installation as affected by temperature and pressure is presented. Much of the paper, however, is a review of previous work. WAT(29)

Some Considerations and Tests for Cast Materials for High-Temperature, High-Pressure Service. L. W. Spring. *Foundry Trade Journal*, Vol. 44, June 11, 1931, pages 399–404; Vol. 45, July 2, 1931, pages 7–10, 12; abstracted in *Metal Industry*, London, Vol. 38, June 19, 1931, pages 625–626.

The American exchange paper presented by Spring at the 28th Annual Convention of the Institute of British Foundrymen, held at Birmingham, England, June, 1931. After referring to changes in conditions which have to be met by cast materials in service, the author deals with improvements which have been effected in the manufacture of ferrous and non-ferrous alloys during recent years and then turns to the alloys which have been found suitable for resisting excessive corrosion in service, particularly those having a nickel or an iron base. He devotes considerable space to discussion of the strength of cast materials and deals with the correct design of specimens for the accurate testing of cast materials. The results of a number of short-time tests at high temperatures are referred to briefly, space being devoted to a fuller discussion of creep tests. The results of these tests are illustrated by a number of curves. The question of the deterioration of steels under stress and temperature and the application of creep data to engineering practice are dealt with in some detail. The paper ends with a discussion of wear tests and gives information regarding what is referred to as a score-testing machine. The paper is illustrated by 24 figures and diagrams. OWE+PRK(29)

Effect of Temperature on Materials in Turbine Design. S. H. Weaver. *General Electric Review*, Vol. 33, Nov. 1930, pages 654–655.

The present knowledge of steam turbine development in recent years is reviewed with reference to the flow of metals under stress at temperatures between 700° and 1000° F. Microscopic studies of several investigators for periods of 6 mos. are reviewed for a number of years relative to the creep of metals at 1000° F. The C content is discussed, it appears to have little influence at 1000° F., but is important at lower temperatures. WAT(29)

Determining the Temperature Conductivity Number and the Heat Conductivity Number of Heated Material when the Temperature Gradient is Measured. (Ermittlung der Temperatur- und Wärmeleitzahl von Glühgut aus dem gemessenen Temperaturverlauf.) A. Schack & E. Auhagen. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1931, pages 469–474; *Stahl und Eisen*, Vol. 51, May 14, 1931, pages 615–616.

Report No. 84 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Whereas a previous investigation (*Stahl und Eisen*, Vol. 50, 1930, pages 1289–1297) considered methods for calculating the temperature course in the interior of the heated body when its surface temperature is known, the present investigation deals with the determination of the temperature conductivity number and the heat conductivity number by means of the measured temperature course. The calculation is based upon measurements of the temperature gradient of steel ingots in rolling mill furnaces and the temperature gradient of piled material, as borings, annealed wire, etc. In the first mentioned case, a comparison between calculation and measurement shows the temperature gradient between top and bottom surface of the ingots was calculated too large at the beginning of the heating but too small at the end of heating. This is due to the pronounced variability of the temperature conductivity number of Fe. In the beginning of the heating, the temperature conductivity number is much larger than the mean temperature conductivity number which has been used in the calculation. The conditions are reversed at the end of the heating. Taking into account the above systematic deviations from the mean temperature conductivity number, the temperature course can be calculated satisfactorily. The rapid decrease of the temperature conductivity number with increasing temperature is due to the increase of the specific heat and the decrease of the heat conductivity number. Other conditions prevail in heating piled material since, here, the radiation in the cavities plays a decisive rôle, for the radiation rapidly increases with the temperature. The temperature conductivity number of piled material is much less variable than that of solid bodies. The heat conductivity number of piled material increases with the temperature. The heat conductivity number of borings is small and of about the order of refractory bricks. Annealings in borings require a long time. GN(29)

The Specific Heat of Metals at Very Low Temperature. (Die specifisches Wärme von Metallen bei sehr tiefen Temperaturen.) J. N. van den Ende. *Metallwirtschaft*, Vol. 10, Aug. 28, 1931, pages 676–680.

Thirty-four references. Several theories on the lowering of the atomic heat at low temperatures and its relation to superconductivity are discussed. Recent measurements of specific heat of metals at temperatures of liquid H and lower have been made in Germany and Holland by the Nernst method. Details of the apparatus used by both schools are described, especially in regard to heat insulation, heating and temperature measurement. In the author's apparatus a copper core containing the heating and measuring wires was screwed into the metal block. The heating wire consisted of constantan and the thermometer wire of gold or constantan. He gas was admitted through a lead tube which was later closed by soldering. The results obtained agree in general with the Debije theory, but several exceptions have not been explained. At the He temperature, the specific heats of Hg, Pb, Bi, Zn and Sn have been determined. The specific heats of Pb and Bi at 3° to 20° K. are shown in graphic form. Still more accurate measurements are necessary for a complete understanding. CEM(29)

Direct Methods for Determining the Density of Melts, Especially of Metals at High Temperatures. (Ueber die direkte Auftriebsmethode zur Dichtebestimmung von Schmelzen, inbesondere von flüssigen Metallen bei hohen Temperaturen.) F. Sauerwald & E. Widawski. *Proceedings World Engineering Congress*, Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 1–4.

A displacement method, using a refractory plummet carried on an analytical balance, is described, and curves given for tin and copper. Specific volume of Sn with about 1/2% Sb ranges from 0.1484 at 600° C. to 0.1580 at 1280° C.; of Cu from 0.1260 at 1100° C. to about 0.1307 at 1500° C. HWG(29)

The Demands to be Made of Heat-Proof Metallic Materials and Their Testing. (Die anhitzebeständige metallische werkstoffe zu stellenden Anforderungen und ihre Prufüng). O. Hengstenberg & F. Bornefeld. *Krupp'sche Monatshefte*, Vol. 12, June 1931, pages 153–158.

In the first part of the paper, the properties required of heat-proof metals are discussed and it is pointed out that the selection of a material must be made for each individual case after collaboration of consumer and producer. The second part describes the testing methods which are especially important for new alloys. The test should imitate and take into account as much as possible conditions of actual service. Determinations of corrosion-resistance are particularly difficult in the laboratory at high temperatures for which some limits are given. 17 bibliographical references are included. Ha(29)

Heat-Resisting Alloys in Furnaces. L. J. STANBERY. *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 1031–1035; Sept. 1930, pages 1191–1196; Oct. 1930, pages 1322–1324, 1328.

Starting from the fundamental physical and chemical characteristics of alloyed metals, which are explained by their lattice configurations, the properties given to alloys by the use of various chemical elements and by heat treatment are described. The basic heat-resisting alloy is a combination of Cr, Fe and C with sufficient Ni added to maintain a normal austenitic structure at all temperatures below the δ-Fe or softening point. The analysis of several such materials is given and the heat treatment is described. The resistance to oxidation and to furnace gases at high temperatures is discussed; means are suggested for increasing it by proper alloying. Several types of stainless steels are analyzed and their treatment and characteristics and fields of application are described. Some directions and precautions for the use of these materials in design and foundry practice are given. Ha(29)

The Dependence of the Plasticity of Crystals on the Temperature. (Ueber die Temperaturabhängigkeit der Plastizität von Kristallen.) E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 18, 1931, pages 23–25. Also in V.d.3. Intern Kongr. f. tech. Mech. Stockholm, 1930, page 249.

The critical translation-stress or beginning of plastic deformation of a single crystal is very low, some thousand to ten thousand-fold smaller than is called for by theory. It might be thought that at very low temperatures it might rise to the theoretical value, but at 1.2° and 4.2° absolute, the plastic deformation in Cd is still very low. After plastic deformation has started, the critical stress rises, i. e., the material work hardens and this hardening is very dependent upon temperature. In Cd it is very much more marked at −253° C. than at room temperature. It is also dependent on rate of deformation. The effects of both these factors affecting the work-hardening are ascribed to crystal recovery. At higher temperatures, the recovering follows the deformation more closely till finally deformation without hardening ensues. The energy of deformation of the Cd crystal is constant from 100° to 475° absolute. It is the thermal crystal recovery which prevents hardening through slip at high temperatures. The allowing of too short a time for this crystal recovery at ordinary temperatures may account for the "strengthening by understressing" through very tiny slipping of the crystal in endurance testing. HWG(29)

The Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron. A. L. NORBURY & E. MORGAN. *Iron & Steel Institute, Advance Copy* No. 11, May 1931, 22 pages; *Foundry Trade Journal*, Vol. 44, May 14, 1931, pages 338–343; *Iron & Steel Industry & British Foundryman*, Vol. 4, May 1931, page 276; *Engineer*, Vol. 151, May 22, 1931, page 566.

A study of growth of cast iron by dilatometric measurements indicated that growth of cast iron increased with increasing Si content up to 3 or 4%, but that as the Si was further increased growth decreased. More severe tests made by heating the iron to temperatures between 600° and 1000° C. in moist CO_2 confirmed this finding. Growth in the high Si irons resulted if the graphite flakes were very large. An iron was developed which contained from 4 to 10% Si with finely divided graphite, which is to be marketed under the name "Silal." Growth is attributed to (1) decomposition of combined C, (2) external and internal oxidation, and (3) crack formation. The ability of high Si iron to resist growth is attributed to the raising or obliteration of the α-γ transformation. Contains 13 references.
JLG+OWE+CHL+LFM(29)

The Fabrication of Pistons for Gas Engines and the Thermal Treatment of Cast Aluminum Alloys. (La fabbricazione dei pistoni per motori a scoppio e il trattamento termico delle leghe di a luminio da fonderia.) C. PANSERI. *La Metallurgia Italiana*, Vol. 23, June 1931, pages 500–522; July 1931, pages 624–643; Aug. 1931, pages 732–752.

A correlated abstract, to be published in 3 parts. The first part deals with coefficients of expansion, design of pistons, hardness and its importance in pistons, equilibrium diagrams for Al-Si, Al-Cu, Al-Mg_2Si, comments on the effect of additions of Ni, W, Li, Ti, B, V, effect of use of Cl and of the chlorides of Ti and B as degasifiers, and the modification of Al-Si alloys by Na, Ca, etc. Practically all the information given is available from other sources, most of it in English. Part 2. Some 70 aluminum piston alloy compositions, specifications and properties (where known) are given with trade names or designations. Short-time tensile tests at various temperatures are plotted. The strongest shown are at 250° C. "G97" (13.5% Cu, 0.8% Fe, 0.8% Mn) 31,000 lbs./in.^{2}; "RR53" heat-treated (2.25% Cu, 1.3% Ni, 1.6% Mg, 1.4% Fe, 0.1% Ti, 1.25% Si) 44,000 lbs./in.^{2} and alloy "X" heat-treated (3.6% Cu, 0.6% Mg, 1.25% Fe, 0.7% Si, 0.7% Ni) 34,000 lbs./in.^{2} The high Si, low expansion alloys are briefly discussed. Part 3. The rich alloys by which the alloying elements may be added are tabulated; the solidification shrinkage of the piston alloys and its bearing on methods of casting pistons, and finally the various casting methods and both melting furnaces and those for heat-treatment, are discussed. The series of articles forms a rather complete résumé of the subject. HWG(29)

Determination of the Creep Limit. W. ROHN. Publication in Honor of the 70th Birthday of Wilhelm Heraeus (Festschrift zum 70 Geburtstag von Wilhelm Heraeus), pages 80–96; 1930; published by G. M. Albertis Hofbuchshandlung, Bruno Clauss, Langstrasse 47, Hanau, Germany.

The fundamentals of creep are discussed, and the relation of creep to notched impact, tensile strength, yield point and elastic limit. Above certain temperatures, which differ for each material, tensile strength, yield point and elastic limit in the proper sense no longer exist, but converge asymptotically whenever the duration of the test amounts to several hundred or thousand hours. In the range of high temperatures, under the action of surprisingly small loads, a slight and gradually increasing creep of the material takes place. A new method of studying the creep characteristics is shown and the test method discussed. The test specimen itself provides automatic regulation of temperature and creep in the testing furnace after the manner of a dilatation thermometer. Starting with a cold test specimen in a cold furnace and switching on the heating current of the furnace, the furnace together with the test specimen gradually becomes heated, the test piece simultaneously increasing in length, being under a fixed load. As soon as a certain elongation is obtained, an electrical contact is actuated, shutting off the current to the heating element. If, subsequently, furnace and test specimen cool to a certain extent, and so contract, the contact is reconnected, the heating current is once more applied and the specimen reheated so that the cycle starts over again. The limits within which this process takes place are from 4–8° C. This cycle repeats indefinitely as long as the fixed load on the test piece is below the creep limit of the material under test. If, however, the load is greater than the creep limit, besides the alternating thermal elongation and contraction a gradual elongation due to creep will occur. The furnace temperature in such a case will gradually decrease to a temperature at which a permanent elongation under the influence of the load no longer takes place. This temperature will then remain constant. The load carried by the specimen is the creep limit at this temperature. Only a few preliminary experimental results are reported. An alloy containing 15% Cr, 7% Mo, 16% Fe, 60% Ni and 2% Mn annealed at 1050° C. showed a creep limit of 427 lbs./in.^{2} at 838° C. by this method, the temperature having dropped in 48 hours from 1080° to 838° C. before equilibrium was reached. WAT(29)

REDUCTION METALLURGY (31)

Production of Ferro-Titanium. S. S. STEINBERG & P. S. KUSAKIN. *Transactions Institute Economic Mineralogy & Metallurgy*, Moscow, 1929, No. 43, pages 5–44.

The object of this investigation is to determine the conditions of reduction by C of Ti from ores rich in TiO_2 in the process of preparing ferro-carbo-titanium, and to investigate the possibilities of obtaining the commercial alloy under the conditions existing in the Urals. The experimental work consisted in determining the following: 1. Influence of temperature on reduction of Ti. 2. Influence of Ti concentration in the melt on reduction temperatures. 3. Influence of slags on reduction temperatures. 4. Reduction of Ti from titano-magnetite. The following materials were used in the investigation: 1. Titanium ore containing 50–56.5% TiO_2, 34.25–48.55% FeO and 2.27–4.5% MnO. 2. Titano-magnetite with 10.2% Ti. 3. Coke, gray iron and fluxes: CaO, MgO, Al_2O_3 and CaF_2. All laboratory melts were made in a Tammann electric furnace in small graphite crucibles. Thirty-two melts were made, varying in temperature and composition of the charge. In the experiments on larger scale conducted at Zlatoust works in a Steinberg and Gramolin electric resistance furnace, the maximum Ti content obtained in the alloy was 1%; the remaining Ti went to slag. This type of furnace was not suited for the preparation of the alloy because the required high temperatures could not be obtained. Using an arc furnace, 80–90% reduction of Ti was obtained with an energy consumption of about 13 kw.-hrs./kg. of ferro-titanium. Attempts to make large melts in a large electric arc furnace at Porogi Works gave negative results owing to the unsuitability of the furnace, which was designed for steel melting but not for making ferro-alloys. Thermodynamic calculations for the reduction of Ti by C made by the authors show that TiO_2 can be reduced by elementary C, not by CO. The theoretical temperature of complete reduction of TiO_2 to Ti was found to be 1897° C.; 100% reduction is impossible in practice because of the large excess of C. Temperatures of reduction of Ti in ferro-titanium ores of varying Ti content (0–100% Ti) and with varying CO pressures were calculated. Curves are given showing elation between Ti concentration, temperature and partial pressures of CO. These curves show that lowering Ti concentration in the melt lowers the temperature of its reduction and, therefore, the temperature of the whole reduction process. This is in full agreement with experimental results. The curves also show that the reduction temperature depends on the concentration of CO in the furnace atmosphere. Conclusions: Temperature of reduction of Ti from ferro-titanium ores depends (at the same CO concentration in the atmosphere) on the Ti content in the charge. The lower the Ti content the lower the temperature of complete reduction. With the concentration of Ti in the charge necessary to obtain 5% Ti ferro-titanium alloy, complete reduction of Ti is obtained at 1480° C; 10–12% Ti alloy is obtained at about 1680°. Further increase of Ti content (carbide) in the melt raises the melting temperature because the melting point of Ti carbide is very high (3170° C.). Alloy with 14–18% Ti and 5–7.5% C can be obtained only at temperatures above 1680–1750°. In preparing alloys with 19–21% Ti, 80% reduction is obtained at 1700° and 92% at 1940°. Therefore, under the existing plant conditions (Ural) the preparation of ferro-carbo-titanium alloy with Ti content above 20% is impracticable. Alloy with 21% Ti and 0.10% C melts at 1400–1420° C. which is in accordance with the Fe-Ti equilibrium diagram. Because of the easier formation of the Ti carbide than of metallic Ti in the furnace, it is easier to obtain ferro-carbo-titanium than low C ferro-titanium. The latter can be obtained by reduction with Al. On the basis of these experiments, the following recommendations are presented as to the furnaces and the process of obtaining ferro-titanium: (a) Arc furnaces are best suited for obtaining high temperatures necessary in the process; (b) a steel melting type of furnace with an arched roof is suggested in order to heat both the metal bath and the slag; (c) Ti is reduced from Ti ore covering the metal bath in the form of slag by the C of the bath wherefor the bottom should be made of coke; (d) no addition of fluxes (lime) is needed because it raises the reduction temperature of Ti; the charge should consist of ore, coke and scrap iron in corresponding proportions; (e) a Siemens type furnace with one upper moving electrode and one bottom electrode is best suited for the process; (f) either ilmenite or titano-magnetite can be used as the ore. Sketches of the furnaces and complete records of all melts are given. BND(31)

The Production of Pig Iron with a High Content of Alumina in the Burden. (Die Erzeugung von Roheisen bei einem hohen Tonerdegehalt des Möllers.) M. PASCHKE & E. JUNG. *Archiv für Eisenhüttenwesen*, Vol. 5, July 1931, pages 1–8.

The pig iron was made of a burden of scrap, bauxite and limestone. The slag contained on the average 7% SiO_2, 40% CaO and 45% (Al_2O_3 + TiO_2). The average composition of the pig iron produced is C, 5%; Si, 0.3%; Mn, 0.5%; P, 0.13%; S, 0.02%; Al, 0.02%. The high carburization of the pig iron is due to the viscosity, amount and temperature of the slag and the small content of Si is due to the low Si concentration of the burden. The structure of the pig iron is purely pearlitic and the graphite is most favorably crystallized. The amount and temperature of the slag favor a far reaching desulphurization of the pig iron. The heat balance of the blast furnace is dealt with. Running the furnace with such a high content of alumina in the burden offers no difficulties. GN(31)

Some Aspects of the Iron Ore Situation. F. B. RICHARDS. *Mining & Metallurgy*, Vol. 11, Sept. 1930, pages 435–436.

A discussion of present condition of ore supplies and of the question of the successful commercial use of the enormous tonnage of low grade ore by proper concentration for the blast furnace. Ha(31)

Experimental Investigations of Different Gas Burners of Blast Furnaces. (Recherches expérimentales sur différents brûleurs au gaz de hautsfourneaux.) MARCEL STEFFES. *Revue Technique Luxembourgeoise*, Vol. 23, May–June 1931, pages 106–108.

A classification of gas burners according to aerodynamic and thermal qualities has been attempted. Questions of investment costs, cleaning and maintenance prevent the results from being conclusive. Ha(31)

Gasification of Fuel and Simultaneous Treatment of Ores by Fusion and Volatilization. (La gazéification des combustibles et le traitement simultané des minerais par fusion et volatilisation.) H. PHILIPON. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 437–439.

By treating ferruginous schists, limestone and low-grade coke in a slagging type gas producer, one can simultaneously make gas, high Si pig iron and a slag which can be made into cement. By adding 20% cast iron to the charge, the Si content can be lowered to 2% instead of 9% without such addition. With low S fuel and the use of limestone, the pig produced is low in S. At Vieille-Montagne, the producer is run with the addition of Zn ores or zinc oxide residues, and much of the Zn recovered as dust. Since the efficiency of the producer is about 70%, low grade ores can be treated. HWG(31)

Germanium—XXXVI. Extraction of Germanium and Gallium from Germanite—I. W. I. PATNODE & R. W. WORK. *Industrial & Engineering Chemistry*, Vol. 23, Feb. 1931, pages 204–207.

Eleven references. The process consists in: (1) the direct chlorination of the dry ore and collection of the distillate of anhydrous chlorides; (2) the fractional distillation of the anhydrous chlorides and subsequent hydrolysis of the distillate; (3) the distillation of germanium tetrachloride from the products of hydrolysis and subsequent conversion of the tetrachloride to the dioxide. MEH(31)

ALPHABETICAL INDEX TO ADVERTISERS

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

101 **Modern Refractory Practice.**—The Harbison-Walker Refractories Co., of Pittsburgh, Pa., has published a most complete book on the subject of refractories. Its 178 pages contain a discussion of fireclay, alumina, silica, magnesite and chrome refractories, many tables and formulae useful in their application and much general information on the subject.

102 **Allegheny Metal in Dairy Equipment.**—The Allegheny Steel Co., Brackenridge, Pa., has prepared reprints of an address to the Dairy Engineers' Institute at the National Dairy Exposition in October As its name indicates it is a discussion of results obtained from the use of austenitic chromium nickel steel, commonly known as "18-8," in dairy equipment.

103 **Bright Annealing.**—The Process Engineering & Equipment Corporation, 5 Falmouth St., Attleboro, Mass., makes special furnaces for bright annealing in one operation. A folder issued by them shows one of their installations.

104 **Vanadium Steels.**—The Vanadium Corporation of America has recently revised and re-issued its specifications 3B to 9B inclusive, covering vanadium steels for various purposes. Copies of the new specifications can be obtained from the company.

105 **Refractories.**—Corhart "Electrocast" is a new refractory produced by a patented process. It is said to have a porosity of less than 0.5% and has a fusion point of cone 35. "Electroplast," made by the same company, is a plastic refractory used for patching or for applying as a protective coating on refractory walls or bottoms.

106 **Combustion Control.**—Bulletin No. 660 describes L & N Metered Combustion Control equipment by which metered quantities of fuel and air are supplied to each boiler and uniform steam pressure and correct furnace pressure are maintained. The bulletin is fully illustrated. The company also issued several bulletins on their Hump hardening method and their Homo heat-treating furnaces.

107 **Bronze.**—Interesting pictures of the bronze work in the new Waldorf-Astoria are reproduced in the December issue of the Bulletin of the Copper & Brass Research Association. Several unusual applications of copper and brass are also discussed.

108 **Liquid Heating Furances.**—A recent folder sent out by the Surface Combustion Corporation, Toledo, Ohio, describes an installation of one of their continuous lead hardening furnaces designed for hardening ninety hubs an hour.

109 **Castings.**—An attractive booklet prepared by The British Aluminium Co., Ltd., 122 East 42nd Street, New York, gives technical details on melting practice for aluminum alloys, specifications for casting alloys and heat treatment of aluminum alloy castings.

110 **Metal Spraying.**—A folder issued by the Metallizing Company of Los Angeles, Ltd., 1218 Long Beach Ave., Los Angeles, describes a new gun they have developed for metal spraying. It can be used to give non-metallic products the appearance of solid metals or to make some metallic product rust-proof. Cloth can be sprayed with metal and so can glass, plaster and most other materials.

111 **Pot Furnaces.**—Bulletin No. 10 of the American Electric Furnace Co., Boston, Mass., is devoted to their Model P—Cylindrical Type Pot Furnaces. A cross-section diagram of the furnace is shown.

112 **The Laboratory.**—The Vol. 4, No. 4, issue of this publication of the Fisher Scientific Co., Pittsburgh, Pa., contains accounts of a new hot wire cutter for the laboratory, a new temperature recorder and a new vacuum meter.

113 **Recording Instruments.**—Bulletin GEA-1061D of the General Electric Company describes their strip-chart recording instruments for alternating and direct current and gives data on their switchboard voltmeters and ammeters.

114 **Pyro Rapid Recorder.**—The Pyrometer Instrument Co., 103 Lafayette St., New York, has sent out a pamphlet announcing their rapid recorder radiation tube for measuring the temperature of fast moving objects or rapidly changing temperatures.

115 **Gears Made of Armor Plate.**—The International Nickel Company, 67 Wall St., New York, has issued reprints of an article which appeared in *Metal Progress*. It is concerned with two nickel alloy steel compositions which have proved reliable in rear axle and transmission gear construction.

116 **Cataract Metal.**—This is an alloy developed by the Niagara Falls Smelting & Refining Corp., Buffalo, N. Y. It is a nickel base alloy of silver white color and is discussed in a leaflet sent out recently by the company. It has great ductility, high tensile strength and chemical resisting powers.

117 **Grinding.**—The October issue of *Grits and Grinds*, published by the Norton Company, Worcester, Mass., features an article entitled "Grind Side Milling Cutter" and a write-up on the Norton Automatic Cam Grinder.

118 **Alloy Steel Castings.**—An attractive pamphlet prepared by the Duriron Co., Inc., Dayton, Ohio, discusses the corrosion resistance of their Durimet and Durco Nirosta and gives technical data concerning them.

119 **Electric Decorating Kiln.**—Bulletin K-101 of the Ajax Electric Co., Inc., Philadelphia, Pa., is devoted to their electric circular decorating kilns.

120 **Pickling.**—Several circulars on their rotary pickling machine can be obtained from N. Ransohoff, Inc., W. 71st St. at Millcreek, Cincinnati, Ohio. A photograph of the equipment will be furnished if desired.

121 **Foundry Practice.**—An interesting article on cupola refractories is the keynote of the December issue of *Better Methods*, published by Beardsley & Piper Co., 2541 North Keeler Ave., Chicago, Ill.

122 **Carbon Tetrachloride.**—This booklet published by the Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y., contains information on the properties, specifications and commercial application of the non-flammable solvent, carbon tetrachloride.

123 **Electric Foundry Equipment.**—Bulletin GEA-1413 of the General Electric Company is devoted to a full exposition of their electric equipment for foundries. It is a profusely illustrated booklet of 50 pages and contains a list of other G-E publications of interest to foundrymen.

124 **Zinc Die Castings.**—The New Jersey Zinc Company, 160 Front St., New York, has compiled a booklet containing many unusual pictures of zinc die castings, from toy autos to parts for motion picture cameras and phonographs.

125 **Plykrome.**—This stainless composite steel is discussed in a folder sent out by The Plykrome Corporation, 225 Broadway, New York. It is chromium iron or high-chrome, high-nickel stainless alloy as an integral surface on a backing of mild steel and can be rolled from any alloy which best answers the specific service requirements encountered.

126 **Industrial Heating Equipment.**—Bulletin No. 320 of the W. S. Rockwell Co., 50 Church St., New York, gives a number of typical illustrations of Rockwell electric and fuel furnaces used in the metallurgical, ceramic and chemical industries.

127 **Steel-Mill Motors.**—Bulletin GEK-71 of the General Electric Company describes their type MD Steel-Mill motors especially built for rough service. Specifications for the different size motors are given.

128 **Udylite.**—An interesting application of this plating process is revealed in the August issue of *The Udylite News*, published by the Udylite Process Co., 3220 Bellevue Ave., Detroit, Mich.

129 **Chemical Equipment.**—Booklet No. 100 issued by the F. J. Stokes Machine Company, Tabor Road, Philadelphia, Pa., describes their complete line of chemical, pharmaceutical and special process equipment.

130 **Springs.**—The October issue of the *Mainspring*, published by the Wallace Barnes Co., Bristol, Conn., features an article on "Flat Springs, a few Suggestions Regarding their Design."

131 **G-E Thrustor.**—The General Electric Company has issued a pamphlet announcing their thrustor which is a new electric device which exerts a smooth, powerful thrust. It can be installed on hand- or foot-operated machines. Their bulletin GEA-1262A gives full information on this line of equipment.

132 **Hipernik.**—The International Nickel Company, 67 Wall St., New York, has issued as a reprint an article entitled "Permeability of Hipernik reaches 167,000" written by T. D. Yensen which appeared in *The Electric Journal.*

133 **Chrome Brick.**—Bulletin 1-13-15 of the E. J. Lavino & Co., Bullitt Building, Philadelphia, Pa., stresses the unusual chemical and refractory properties of chrome ores in the manufacture of refractories. Physical properties of brick made by their improved process are illustrated. Several of their pamphlets show the application of these bricks in basic open-hearth furnaces, in soaking pits and recovery furnaces.

134 **Refractories.**—Hytempite is a dense, plastic refractory material, scientifically compounded, for bonding fire brick and for kindred uses. A 23-page booklet giving numerous suggestions for its application has been compiled by the Quigley Company, Inc., 56 West 45th St., New York. A leaflet published by the same company discusses their dry refractory cement, Pyro-mortar.

METALS & ALLOYS, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below.

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GENERAL (0)

Tensile Properties and Stress. (Festigkeitseigenschaften und zulässige Spannungen.) E. SIEBEL. *Stahl und Eisen*, Vol. 51, June 25, 1931, pages 785-788.

Report No. 176 of the Committee on Materials of the Verein deutscher Eisenhüttenleute. The properties of materials which must be taken into proper consideration for the manifold types of application are discussed. The author endeavors to settle the question as to what tensile properties the calculations of the construction engineer must be based upon and to what extent the fundamental properties have been investigated. Proposals are made as to the accumulation of data for the calculations of the constructor. GN(0)

Possible and Efficient Quality Requirements and Their Increase by Mass Production. (Mögliche und zweckmässige Güteanforderungen und ihre Steigerung durch die Massenerzeugung.) K. SCHIMZ. *Stahl und Eisen*, Vol. 51, June 11, 1931, pages 729-734.

Report No. 175 of the Committee on Materials of the Verein deutscher Eisenhüttenleute. Includes discussion. The article gives a résumé on the experience in manufacturing bolts and nuts; discusses in detail the failures and outlines the remedies. It is shown that at any rate mass production necessitates an increase of the quality of the material used. Producer and consumer should coöperate to this end. GN(0)

When Designing Steel Castings. ERNEST VEIHL, JR. *Product Engineering*, Vol. 2, Aug. 1931, pages 352-354.

The designer must be absolutely familiar with the mechanical properties of the materials to be employed and the means of shaping castings to obtain a good foundry product. This is particularly important in the case of very large castings of complicated form. Ha(0)

Theory and Practice. (Wetenschap an Techniek.) A. VOSMAER. *De Gieterij*, Vol. 5, June 1931, pages 78-79.

In dealing with alloys, volume percentages would be more useful than either weight percentages or atomic percentages. HSvK(0)

Weight of Monel Metal Sheets. J. K. OLSEN. *Metal Stampings*, Vol. 4, Mar. 1931, page 266.

This table gives weight in lbs./ft.^{2} for monel metal sheet ranging in thickness from 2 in. to $^9/_{16}$ in. and from No. 0000000 (= $^1/_2$ in.) to No. 38 U. S. Standard gage. Weight/ft.^{3} equals 558.14 lbs. JN(0)

Weight of Sheet Iron. J. K. OLSEN. *Metal Stampings*, Vol. 4, Apr. 1931, page 356.

This table gives the weight in lbs./ft.^{2} for sheet iron from $^1/_2$ in. in thickness to No. 38 U. S. Standard gage. Weight/ft.^{3} equals 480.0 lbs. JN(0)

Weight of Aluminum Sheets. J. K. OLSEN. *Metal Stampings*, Vol. 4, Feb. 1931, page 162.

This table gives the weight in lbs./ft.^{2} for aluminum sheet ranging from 2 in. to $^1/_{16}$ in. and from No. 0000 to No. 46 B. and S. gage in thickness. Weight /ft.^{3} equals 167,098 lbs. JN(0)

Non-Ferrous Metallurgy in 1930. SAM TOUR. *Mining & Metallurgy*, Vol. 12, Jan. 1931, pages 49-55.

Review of theoretical metallurgy, Cu and Cu alloys, bronze and red brass foundry metallurgy, non-ferrous metals and alloys, secondary metals, Ni and Ni-Cu alloys, Pb-Sn and their alloys, and precious metals. Ha(0)

Iron and Steel Metallurgy in 1930. CLYDE E. WILLIAMS. *Mining & Metallurgy*, Vol. 12, Jan. 1931, pages 32-36.

Review of the progress made during the year in blast furnace practice, the physical chemistry of steel making and in the rapidly increasing uses of corrosion-resistant steels. Ha(0)

Metallurgical Terms. *Metallurgist*, Apr. 1931, pages 49-50.

The scientific metallurgist is sometimes accused of employing abstruse technical terms when stating the results of his researches, with the consequence that the "practical man" is, for that reason, unable to understand what the scientific man has done or what he means. The scientific investigator, attacking new fields of knowledge, is bound to develop new ideas as well as to discover new facts, and for these new conceptions he must necessarily employ new or at least special and precisely defined terms if he wishes to record—as he must—exactly determined results in equally exact language. The coining of new terms is, therefore, scarcely to be avoided but they should be limited to as few as possible. The present habit of applying different meanings to the same word is also confusing. "Metallurgy," while applying to everything relating to the science and art of reducing metals from their ores, is also applied more specifically to the physical properties and heat treatment of metals and alloys. "Physical Metallurgy," while an improvement, still does not cover the subject. In France, the whole field is covered by "Metallographie" which, by English-speaking scientists, denotes only the microscopic examination of metals. The ability of a metal or alloy to improve its physical properties by heat treatment, usually quenching followed by aging, has acquired the term age-hardening. In German, this quality is denoted by the very satisfactory adjective "vergütbar." However, the Deutsche Gesellschaft für Metallkunde has decided to replace this word with "aushärten" apparently to make a distinction between quenching and tempering as opposed to quenching and aging. Apparently all that can be hoped for in metallurgical terminology is the gradual development of a simple, logical and consistent system which the increasing intercourse and exchange of ideas between the workers of different nationalities will lead to the establishment of definitely equivalent terms between the different languages concerned. VVK(0)

Standard Metal Directory. Atlas Publishing Co. Inc., New York, 1931. Cloth, 6 × 9 inches, 778 pages. Price $10.

This directory lists the producers, refiners and manufacturers of ferrous and non-ferrous products. They are arranged geographically. Some of the subjects covered are: Babbitt and solder manufacturers, cable and wire manufacturers, copper refineries, ingot steel manufacturers, gray iron foundries, foil manufacturers, rolling mills, tin plate mills, etc.— M. L. MOORMAN(0)-B-

Platinum in the Sun. *Scientific American*, Vol. 146, Jan. 1932, page 59.

The sun is estimated to have 50,000,000 tons of Pt in the form of a gas heated to a temperature of 11,000° F. WAT(0)

Metallurgical Research During 1929. *Chemical Age*, Vol. 22, June 7, 1930, Metallurgical Section, pages 33-34.

Abstract from the 1929 report of the National Physical Laboratory, Department of Metallurgy and Metallurgical Chemistry. Brief description of the work done on "Y" alloy and alloys of Ni and Cr. VVK(0)

Metal Statistics, 1931. American Metal Market, New York, 1931. 24th Edition. Cloth, 4 × 6 inches, 552 pages. Price $2.00.

The 1931 edition of this compact little book contains statistics on ferrous and non-ferrous metals for 1930 and preceding years. Tables showing the production, consumption, average prices, exports, imports, etc., are given. Various new tables have been added which will increase the usefulness of the book.—M. L. MOORMAN(0)-B-

Coöperative Research in the Iron and Steel Industry. *Foundry Trade Journal*, Vol. 45, Aug. 27, 1931, pages 130-131.

Abstract of a paper by Dr. F. N. Speller, which was read before the American Iron & Steel Institute. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 159. OWE(0)

PROPERTIES OF METALS (1)

The Problem of the Electrical Conductivity of Metals. C. D. NIVEN. *Canadian Journal of Research*, Vol. 5, July 1931, pages 79-86.

The author points out that mathematicians, in attempting to form theories of electrical conduction, lay no emphasis on the fact that resistance, as a rule, does not vanish at low temperatures. When it does, it vanishes suddenly. The question, therefore, arises as to whether the right model for conductivity in a metal is visualized. The author suggests that fundamentally a metallic atom is one in which the electron configuration is incomplete. Ordinary conduction is a process whereby the electron jumps from one atom to another, remaining with the atom it jumps to until it is in equilibrium with the motions of the electrons already on that atom. In the super-conducting state, the electronic orbits of different atoms become synchronized so that when an electron leaves one atom, another electron immediately arrives to take its place. Studies of the resistance-temperature curves and of other phenomena emphasize the importance of structure in conductivity. OWE(1)

Pure Metals. (Reine Metalle.) WALTER NODDACK. *Metallwirtschaft*, Vol. 10, Aug. 28, 1931, pages 674-676.

For certain physical measurements, metals of exceptional purity are necessary. Many disagreements in measurements by different investigators have been traced to metals of different purity. The purity of metals is sometimes limited by the available analytical methods. The process of obtaining pure metals consists of determining the impurities, producing a pure metallic compound and separating the metal from its compound. The purity can be checked by measuring the temperature coefficient of electric conductivity, resistance at low temperatures, hardness, electric conductivity in a strong magnetic field, by obtaining the optical or X-ray spectrum or by numerous chemical reactions. Some chemical methods are sensitive to 10^{-9}. Fractional crystallization and distillation are frequently used to obtain pure compounds. Reduction to the metal is accomplished by thermal, electrical or chemical means, especially by melting in a vacuum, the production of wires by thermal dissociation of gaseous metallic compounds or by electrolytic plating in sheet form. A number of metals have been produced with total impurities 10^{-3} to 10^{-5}. CEM(1)

Technology and Tensile Properties of Pure Aluminum. (Technologie und Festigkeitseigenschaften von Reinaluminium.) G. SACHS & J. WEERTS. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June 1931, pages 182-236

Three grades of pure aluminum are commercially produced: (a) Al 99.5 with more than 99.5% Al (in America, "special"); (b) Al 99 with more than 99% Al ("grade 1" or "grade A" in the U.S.A.); (c) Al 98/99 with 98-99% Al ("grade 2" or "grade B" in the U.S.A.) Al with 99.7 to 99.8% can be had without difficulty; the impurities are Fe, Si or traces of Cu. The Aluminum Company of America produces an aluminum of 99.8 to 99.9% which has a somewhat lower tensile strength. The influence of the impurities is explained. A complete treatise on casting, influence of casting temperature, machining, workability, pressing, drawing, tools for cutting, milling, threading, boring, sawing, filing, grinding is given. Heat treatments for obtaining recrystallization and certain properties are described in detail. Tensile properties and electric conductivity are tabulated for different degrees of purity. Extensive tables which show the influence of annealing of different durations on the tensile strength are added. The crystal structure is exhaustively discussed and directions are given for the production of uni-crystals (crystals in which one crystal fills the whole section and has a sufficient length for undisturbed behavior during working). The mechanical properties, their tests and results are described by means of tables, curves and formulas. A separate chapter is devoted to the influence of temperature and is illustrated by curves. Corrosion is treated in the same manner. The paper is supplemented by a list of 269 references. Ha(1)

Compressing Powdered Carbonyl Iron by Treatment with Heat and Compression. (Ueber die Verfestigung von pulverförmigen Carbonyleisen durch Wärme- und Druckbehandlung.) L. SCHLECHT, W. SCHUBARDT & F. DUFTSCHMID. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.-Sept. 1931, pages 485-492.

Carbonyl iron is the product of the thermal disintegration of iron carbonyl when metallic iron is formed under the development of carbon monoxide. It is an extremely fine iron powder and consists of small spheres of a diameter of 1×10^{-3} cm. to 1×10^{-4} cm. Carbonyl iron shows a remarkable crystal growth when heated; this quality is ascribed to its purity, the low temperature of its formation and the small size and sphericity of the powder particles. It has an extraordinary ability to sinter which makes a technical production and application of carbonyl iron possible. It is very soft and possesses a deep-drawability like Cu. Its technological properties, hardness, elongation, elastic limit, tensile strength are as good as those of pure Fe produced by smelting. It is more resistant to corrosion than other types of pure Fe and has a high original permeability (μ_0 = 3000) and a low coercive force (H_c = 0.07) when annealed in vacuum in a current of H. The carbonyl iron alloys are equally excellent with regard to mechanical and magnetic properties, due to freedom from S and P. In the discussion, several points concerning precipitation of a metal from a gas were mentioned. 13 references. Ha(1)

Some Electrical Properties of Spectroscopically Pure Zinc Crystals. A. G. HOYEM. *Physical Review*, Vol. 38, Oct. 1931, pages 1357-1371.

With single crystal specimens of spectroscopically pure (99.9999%) Zn, the Thomson coefficient at 49.5° C. has been measured as a function of orientation. A very accurate confirmation of the Voigt-Thomson symmetry relation is obtained; the principal values of the Thomson coefficient are $\sigma\perp = 0.86 \times 10^{-6}$ cal./coul./deg., and $\sigma\parallel = 0.34 \times 10^{-6}$ cal./coul./deg. The thermal e. m. f. of these same specimens against Cu has been determined as a function of orientation throughout the temperature range −180° to 200° C. From these data, the values of the Peltier coefficient, the Thomson coefficient and the difference in principal Thomson coefficients have been computed as functions of temperature by means of the relations given by the Kelvin thermodynamical theory of thermoelectricity. The values of the Peltier coefficient of Zn⊥ against Zn= thus obtained are π = 658 microvolts at 49.5° C. and π = 1080 microvolts at 125° C. For the difference in the principal Thomson coefficients, the values are $\sigma\perp - \sigma\parallel = 0.58 \times 10^{-6}$ cal./coul./-deg. at 49.5° C. and $\sigma\perp - \sigma\parallel = 1.20 \times 10^{-6}$ cal./coul./deg. at 125° C. The predictions of the Kelvin theory regarding $\sigma\perp - \sigma\parallel$ are thus found to be in agreement with the direct determinations by Ware and the author. The Voigt-Thomson law is found to hold also in the case of thermoelectric power and the other thermoelectric properties to which it should apply. The dependence of resistivity on temperature has been investigated for the temperature range −170 to 25° C. The average value of the temperature coefficient of resistivity obtained is $\alpha = 4.058 \times 10^{-3}$. For comparison purposes, a direct determination of the Thomson coefficients of single crystal specimens of pure Zn (Kahlbaum's best Zn) at 49.5° C. has also been made, as well as a study of the dependence of their resistivities on temperatures. For this less pure Zn the principal values of the Thomson coefficient are $\sigma\perp = 0.91 \times 10^{-6}$ cal./coul./deg. and $\sigma\parallel = 0.38 \times 10^{-6}$ cal./coul./deg. For the temperature coefficient of resistivity, the average value is $\alpha = 4.009 \times 10^{-3}$. A variation in the values of α for specimens of the same grade of Zn is observed which is considerably greater than can be attributed to experimental error. WAT(1)

The Chemistry and Metallurgy of Beryllium. G. M. DYSON. *Chemical Age*, London, Vol. 24, No. 611, 1931, pages 228-230.

A review of the known properties of Be and the possibilities of its practical application. Ha(1)

The Photoelectric Effect in Metals. **(Zum Photoeffekt an Metallen.)** Herbert Fröhlich. *Annalen der Physik*, Vol. 7 (5), No. 1, 1930, pages 103–128.

On the basis of Sommerfeld's wave-mechanical electron theory, a theory of the photoelectric effect in thin layers is developed. With the alkali metals, this theory yields intensity values and maxima for current and light frequency which agree in general with experimentally obtained values. The difference in behavior of a surface toward fast and slow electrons accounts for the direction of polarization. For fast electrons, the atomic structure of the surface is important; for slow electrons, the surface may be regarded as smooth. The distribution of energy of the photoelectrons shows a strong maximum near the maximum velocity. Ha(1)

The Melting Point of Pure Chromium. **(Ueber den Schmelzpunkt des reinen Chroms.)** F. Hoffmann & C. Tingwaldt. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 31–32.

The melting point of pure Cr was determined by an optical pyrometer in 2 ways. In the first, the metal was melted in a high vacuum in a magnesia crucible, and a value of 1800 ± 10° C. was obtained. In the second, the metal was melted by the heating effect of electric current passing through it, and a value of 1765 ± 10° C. was obtained. The reason for this difference is not clear. RFM(1)

Brinell Hardness and Tensile Strength. W. Rosenhain. *Metallurgist*, June 1931, pages 83–85.

The close proportionality between the Brinell test and tensile strength would indicate that the phenomena occurring in the 2 tests were very similar. This is not surprising when it is realised that in both, the material is being subjected to plastic deformation which largely takes place by shear, and that the tensile and compressive properties of steels in a normalized or annealed condition are very similar. The indentation test, therefore, like the tensile test, can be to some extent regarded as a means of measuring the resistance of the material to plastic deformation. However, this relationship does not hold with other metals and alloys. In certain limited groups of alloys there is a proportionality between the 2 sets of data, but the numerical value of the ratio is different from that applicable to steel. On the other hand, there are types of alloys in which there is no proportionality between indentation hardness and tensile strength. In the case of copper containing 0.7% iron it is found that the Brinell number can be raised by age-hardening from 35.8 to 52.5. This result is obtained by first quenching the material from a temperature of 1000° C. and following this by reheating for some hours at 500° C. Yet, in spite of an increase of Brinell number of nearly 50%, the tensile strength only increases from about 13 to 15 tons/in.² A similar observation has been made in regard to the alloys of pure Cu with oxygen (Hanson, Marrayat & Ford. *Journal Institute of Metals*, Vol. 30, 1923, page 197), while in the alloys of the same metal with 0.95% P the Brinell number can be increased from 43 to 52 by quenching and reheating, but there is no appreciable increase in the tensile strength (Hanson, Archbutt & Ford. *Journal Institute of Metals*, Vol. 33, 1930, page 41. See *Metals & Alloys*, Vol. 1, page 788). The author therefore considers the mechanism of deformation as it exists in both the tensile test and the indentation process to find an explanation of these phenomena. His explanation is based upon the consideration of the extent to which intercrystalline cohesion in ordinary polycrystalline metal enters into the results of both tensile and indentation tests. In steel at room temperatures, and in a great many of the stronger metals and alloys, intercrystalline cohesion is so great that by whatever method fracture is produced, it always occurs mainly if not wholly by rupture of the crystals themselves and not by the separation of the crystals from one another—the material fails by trans-crystalline and not by inter-crystalline movement. At elevated temperatures—and in some metals a very slight rise of temperature is sufficient—the intercrystalline cohesion becomes weaker than the resistance of the crystals themselves and the material fails by intercrystalline rupture. Age-hardening is believed to occur as the result of the precipitation, in a state of extremely fine division, of material present in a solid solution in a state of super-saturation. Iron, for instance, is considerably more soluble in solid Cu at 1000° C. than at 500° C., and if the alloy, after annealing at 1000° C., is quenched, and is thereby maintained in the condition of a solid solution, hardening can be brought about by reheating at 500° C. This causes a precipitation of the excess of iron which had been retained in solid solution by quenching. The precipitation of the particles disturbs the regular space-lattice of the Cu and thereby increases resistance to deformation by crystalline slipping. If this view of age-hardening is correct, we should anticipate an increase in the hardness and strength of the crystals of the metal, but it is an open question whether such a precipitation process can have, in itself, any effect on inter-crystalline cohesion. The author's view on this point, based on the conception that there is an intercrystalline layer of more or less non-crystalline or amorphous material between adjacent crystals, is that precipitation, if it occurs at all in these layers, cannot further harden them, since there is no slip mechanism which can be hampered by the presence of dispersed particles. Only where comparatively large quantities of relatively large molecules or crystallites of an inter-metallic compound are deposited from or formed in the alloy matrix need there be any great effect on boundary strength. In such a case, the presence of any considerable number of large molecules or particles would serve to increase the effective viscosity of the intercrystalline layer and thus would serve to raise boundary strength. However, it is only necessary to appreciate the fact that age-hardening, and other methods of increasing the strength of an alloy, may in certain cases increase only the strength of the crystals themselves without altering the boundary strength. Let us now consider the the effect on indentation hardness and tensile strength respectively of a process which increases the hardness and strength of the crystals themselves without materially affecting boundary strength. The result will depend upon whether, in the initial unhardened state, the boundary strength was very considerably, or only slightly, greater than the strength of the crystals. In the former case—where the crystal boundaries are very much stronger than the crystals, the effect of hardening the crystals themselves will clearly be to increase the resistance of the material to plastic deformation of all kinds, and we should expect to find Brinell number and tensile strength increasing proportionately together. This appears to be the case with steel in which, even at slightly elevated temperatures, inter-crystalline rupture can only be produced with the aid of chemical attack. On the other hand, where, in the initial state of the metal, the boundary strength is only slightly higher than the crystal strength, any hardening of the crystals will only produce a slight increase of tensile strength, since rupture will soon occur at, or be initiated by, the failure of the crystal boundaries. Under compression, however, as in the indentation test, the strength of the crystal boundaries does not enter into the question to anything like the same extent, and the indentation test is thus a measure more of the hardness and strength of the individual crystals than of the aggregate. Where, therefore, it is the strength of the crystals which governs the strength of the material, i. e., where intercrystalline cohesion is high, tensile strength and Brinell number will be more or less proportional; but where inter-crystalline cohesion is not very high, there will be little or no relationship between the 2 types of test. This explanation appears to cover satisfactorily the behavior of mild steel and of many alloys, both at ordinary and elevated temperatures. It suggests that in a single crystal the relation between indentation hardness and tensile strength should be particularly close, since boundary strength does not enter into the matter. On the other hand, the mode of deformation of a single crystal is of a peculiar kind, and it might be found that this affects the indentation test in such a way as to interfere with proportionality to the tensile strength. VVK(1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Konel. J. S. Negru (International Nickel Co.). *Metal Industry*, London, Vol. 37, July 4, 1930, page 15.

Brief letter giving the composition of Konel Metal developed by the Westinghouse Electric & Mfg. Co. VSP(2)

Steel and Light Metal. **(Stahl und Leichtmetall.)** P. Schwerber. *Metallbörse*, Vol. 20, July 26, 1930, pages 1658–1659; Aug. 9, 1930, page 1771.

Rustless light metal possesses all the good qualities of steel, besides its own, without the disadvantages of the latter. It is superior to steel because of its low specific gravity (about 2.8), permitting a decrease in weight in constructions of about 60%; greater safety despite a possible decrease in weight, under certain conditions, of 90%; absolute freedom from rusting, obliterating the necessity for protective coatings; longer life; greater thermal and electrical conductivity. It permits of great economic saving. Its use is ushering in a new industrial era. WHB(2)

Aluminium Alloy. *Electrician*, Vol. 107, Sept. 18, 1931, page 384.

A new light alloy with remarkable properties, designated M.V. "C" has been produced by the Metropolitan-Vickers Electric Co. Ltd. It is an Al-Si alloy prepared by a new method. Outstanding properties are strength and ductility. The ultimate strength is 9–11 tons/in.² when sand cast, and 11–13 tons/in.² when chill cast. The alloy can be rolled, drawn, spun, forged, pressed or stamped, and when so worked is greatly improved in strength and ductility. M.V. "C" machines easily and is easily welded. WHB(2)

Hiduminium R R Alloys. **(Les alliages Hiduminium R R.)** *Aciers Speciaux, Métaux et Alliages*, Vol. 6, Mar. 1931, pages 126–128.

Hiduminium alloys comprise 4 Al base alloys in which Ti plays an important part. Ti acts as catalyzer and homogenizer. Its physical properties are: specific gravity, 2.7–2.75; heat conductivity, 0.40 C.G.S.; coefficient of dilation, 0.000022/C.°; melting point, 635° C.; shrinkage in casting, 1.25%. The chemical composition is Cu, 0.50–5.0%; Ni, 0.20–2.50%; Mg, 0.04–5.0%; Fe, 0.50–1.80%; Ti, 0.04–0.60; Si, 0.20–5.0%; Al, balance. The mechanical properties of these alloys are greatly improved after heating for 8–20 hrs. at 155–175° C. GTM(2)

A New Aluminum Alloy. T. W. Bossert & J. A. Nock (Aluminum Co. of America). *Metals & Alloys*, Vol. 2, Oct. 1931, pages 238–239.

The authors describe a new Al alloy containing 1% each of Mn and Mg which exhibits excellent resistance to atmospheric corrosion and workability coupled with high strength which has not been previously attained in a corrosion resistant Al alloy. WLC(2)

Forging of Light Metals. Duralumin. **(Les Forges des Métaux legers Forgeage et Métricage du Duraluminum aux Forges de Bologne.)** A. Vella-Ferrand. *Aciers Speciaux, Métaux et Alliages*, Vol. 6, May 1931, pages 243–250; *Revue de l'Aluminum*, No. 40, Nov.–Dec. 1930, pages 1268–1274.

Heat treatment, forging and testing of duralumin type alloys are discussed. The characteristics and composition of the L.2R (duralumin) alloy, which is worked in a forging plant in Bologne, are as follows:

3.5–4.0% Cu	Tensile strength	57,000 lb./in.²
0.5% Mg	Elastic limit	34,200 lb./in.²
0.5–1.0% Mn	Elongation	16%
95% Al	Melting point	640° C.
traces of Si and Fe		

GTM(2)

Bearing Properties Affected by Variations in Composition. Clai... Upthegrove. *Foundry*, Vol. 59, Jan. 1, 1931, pages 72–74.

The effects of variations of the Sb and Sn contents, of casting and mol... temperatures, rate of cooling on the structure of bearing metals; especially those used in the automobile industry, are discussed. Bronzes with additions of Ni show considerable increase in tensile strength and elongation. The selection of bronzes for worm gears is also discussed. Ha(2)

Tombasil, a New Silicon-Zinc-Copper Alloy. **(Le tombasil, nouvelalliage silicium-zinc-ciuvre.)** E. Vaders. *Cuivre et Laiton*, Vol. 4, Oct. 30, 1931, pages 469–483.

The equilibrium diagram of this ternary alloy is discussed in all its phases. See *Metals & Alloys*, Vol. 1, Dec. 1930, page 898. Ha(2)

Report of Sub-Committee XV on Die-Cast Metals and Alloys. *American Society Testing Materials, Preprint* No. 19, 1930, pages 4–12.

Results of tests of tensile strength, ductility, hardness and impact strength, as affected by exposure to water vapor at temperatures up to 95° C., immersion in heated paraffin and exposure to weather, are given. Disintegration of Zn-base die-casting alloys is due to intercrystalline oxidation; this is accelerated by Sn and Pb as impurities in the Zn, and is reduced by the addition of small quantities of Mg. (2)

Characteristics and Properties of Monel Metal. *Metallurgia*, Vol. 5, Nov. 1931, pages 23–25.

A general discussion of the properties of Monel. Includes a list of mechanical properties and directions for casting and working. JLG(2)

Alloys of Copper—Brasses, Bronzes and Other Materials of Electrical Interest. J. Bradley. *Electrician*, Vol. 107, Nov. 13, 1931, pages 650–653.

An article dealing with alloys in which ingredients other than Cu cannot be regarded as impurities. The alloys discussed are: brass, bronze, phosphor-bronze, gun metal, Al-bronze, Cd-Cu, Mn-bronze or brass, nickel silver and constantan. Tensile strength, yield points and elongation % are given for several of these alloys at various temperatures. WHB(2)

The Beryllium Bronzes. **(Les bronzes an Beryllium.)** *Cuivre & Laiton*, Vol. 4, July 30, 1931, pages 337–340.

A short review of the chemistry and physics of Be. Be is an extremely strong deoxidizing agent and, especially for Cu, preferable to P. Moreover, the density of Cu as well as its electric conductivity are but very little reduced by the addition of Be; an amount of 0.02–0.03% gives a conductivity of 55–56. The metal is then perfectly homogeneous and has a tensile strength of 18–20 kg.–mm.² The Be bronzes usually used contain up to 10% Be, it is so easily poured, the cast metal has an elongation of 36%. It can be rolled with contents up to 3% Be. This bronze shows even better qualities than Sn or Al bronzes. Heat treatment will improve Be Bronze; several methods are described for bronzes of various amounts of Be. Bronze with 2–5% Be, which is not heat treated, has a Brinell hardness of 100 which by proper heat treatment can be increased to 400. Be bronzes have a greater corrosion resistance than steel. The electric conductivity of a 2.5% bronze is about 17–19, while the heat conductivity is about 4/10 that of electrolytic Cu. A bronze of 0.9–1.5% Be seems to give an excellent antifriction metal. In spite of the comparative novelty of this alloy, the experiments have shown an extreme usefulness in many fields. Ha(2)

The Alloy 85-5-5-5 (Cu, Sn, Zn and Pb). *Metal Progress*, Vol. 19, Mar. 1931, pages 104, 106, 110, 112.

Notes prepared for the Data Sheet Committee, Institute of Metals and the Recommended Practice Committee A. S. S. T. WLC(2)

PROPERTIES OF FERROUS ALLOYS (3)

Research Improves Quality of Electric Steel. F. A. Melmoth. *Foundry*, Vol. 59, Aug. 15, 1931, pages 28–31.

Abstract of a paper read at the Chicago meeting of the American Foundrymen's Association. Deals with the tests conducted to determine the causes of certain abnormalities in electric furnace steel. In cast condition, the open-hearth and electric materials are practically identical in tensile strength, yield point, elongation and reduction. Quenching has a marked influence on the tensile and yield points of both materials. Possible controlling causes of the pressure of abnormal structure might arise from one or more of the following: higher temperature in electric steel; existence of non-metallic impurities; some intensely localized high temperature during manufacture. Furnace practice was also studied. To arrive at possible variations of manipulation and conditions in the electric and open-hearth steel manufacture, each step of the process is recorded. Careful observations of difficult castings liable to hot-cracking has indicated a marked reduction in hot-cracking trouble in case of more controlled electric steel. VSP(3)

The Properties of Malleable Casting and Its Application in the Construction of Automobiles. (Die Eigenschaften von Temperguss und seine Verwendung im Automobilbau.) F. Rubensdoerffer & H. Mueller. *Automobiltechnische Zeitschrift*, Vol. 34, June 10, 1931, pages 385–387; June 20, 1931, pages 408–410.

By means of the iron-carbon diagram, the advantages of malleable casting are explained, as also the good pouring quality in connection with great toughness. Process of production, analysis of different qualities, microphotographs of structure and mechanical properties are described. Numerical values and methods of machining are added. Part 2. From comparative tests with different cast materials, the authors conclude that malleable cast iron (especially white castings) is the best material for highly stressed parts with thin walls. It offers, in the construction of automobiles, the greatest economy and the greatest safety of operation. Ha(3)

Characteristics of Alloyed Cast Iron. F. W. Shipley (Caterpillar Tractor Co.). *American Society for Steel Treating, Preprint* No. 25, 1931, 19 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The use of Ni and Cr as alloys in cast iron is discussed and the benefits to be obtained in the uniformity and increased properties are described. WLC(3)

The Precipitation Hardening of Iron by Titanium. (Ueber die Ausscheidungshärtung des Eisens durch Titan.) R. Wasmuht. *Krupp'sche Monatshefte*, Vol. 12, July 1931, pages 159–178.

It has been discovered that Ti is especially capable of producing the so-called "precipitation hardening" in iron which is due to a dissolving and precipitation process of a second, restrictedly soluble phase. This process produces very great hardness, according to the content of Ti. For the commercial percentages up to 3% Ti, the addition of a third element, Si, Ni or others, is necessary to obtain this hardening effect. The changes in hardness, in electrical and magnetic properties of Fe-Ti alloys which have been quenched at annealing confirm the opinion that the precipitation hardening corresponds to the refining of duralumin. The very comprehensive tests which were made to elucidate all the influences of other alloying elements, of annealing and quenching temperatures, cooling velocities are described in detail and the results are reproduced in tables and curves. 14 references. Ha(3)

Steels Used for Drop Forgings. E. T. Walton. *Heat Treating & Forging*, Vol. 17, Oct. 1931, pages 949–953.

An enumeration of types of steel suitable for drop forging, their treatment and physical properties. Ha(3)

Characteristics of Copper Steels. Franz Nehl. *Heat Treating & Forging*, Vol. 17, Feb. 1931, pages 148–150; Mar. 1931, pages 252–255; Apr. 1931, pages 357–359.

See *Metals & Alloys*, Vol. 1, Oct. 1930, page 792. Ha(3)

Growth and Scale Resisting Cast Irons. F. K. Neath. *Bulletin British Cast Iron Research Association*, No. 23, Apr. 1931, pages 364–366; *Iron and Steel of Canada*, Vol. 14, June 1931, pages 95, 101.

A review of the development and present state in the production of a cast iron that does not show growth or scaling has led to the following basic conditions: (1) Since it is scarcely possible to prevent carbide decomposition on repeated heatings, an Fe should contain little or no pearlite from the start. (2) Since any transformation tends to loosen the structure because of volume changes and consequently to promote internal oxidation, such transformation within the working temperatures should be avoided. (3) Since coarse graphite tends to promote penetration of gases, the graphite should be as fine as possible. (4) The metallic matrix must be mechanically dense and must, of itself, resist oxidation and must contain no included gases. Tests of some recent German investigations are briefly described and a few figures on mechanical properties are given. Ha(3)

The Wear of Cast Iron. F. K. Neath. *Bulletin British Cast Iron Research Association*, Vol. 3, July 1931, No. 1, pages 10–13.

Review of recently published papers on this subject. 8 references. Ha(3)

Better Results Obtained from Gears; Change of Treatment Proves Successful. *Edgar Allen News*, Vol. 10, Oct. 1931, pages 976–977.

A set of gears of case hardened steel showed a much longer life than a set of other gears running under the same conditions in a motor truck. The method of heat treating was the following: the steel was held for $3^1/_2$ hrs. at 875° C. and dipped at 880° C., requenched at 770° C. Ha(3)

Gray Iron Possesses Valuable Engineering Properties. Part XII. *Foundry*, Vol. 59, Jan. 1, 1931, pages 61–64, 78; Feb. 1, 1931, pages 92–94.

These installments describe the reasons for growth of cast iron. The method of measuring the growth with a dilatometer is explained and tables of expansion and growth coefficients are given. Ha(3)

Boiler Steels and Other Soft Steels. *Boiler Maker*, Vol. 31, July 1931, pages 184–186.

A brief review of the elements which make up desirable qualities of boiler steels: C, Mn, Si and their amounts. The welding qualities and the methods of welding and testing are discussed. Ha(3)

Influence of Ingot Section on the Properties of Forged or Rolled Steel. (Contribution a l'etude de l'influence de la section du lingot sur les propriétés mécaniques des barres forgées ou laminées en acier.) A. Portevin, M. Prétet & M. Jolivet. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 135–147. 29 figures.

Includes discussion. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 243. HWG(3)

Some Recent Developments in Corrosion-Resisting Steels. J. H. G. Monypenny. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 201–215.

General discussion of stainless and austenitic stainless steels, with emphasis on need for correct heat-treatment. Failures due to intergranular attack are cited. HWG(3)

Tubing of Various Sizes and Alloys. G. P. McNiff (National Tube Co.). *Metal Progress*, Vol. 19, June 1931, pages 60–65, 83.

The author shows that seamless tube process is not limited to the composition range of other tube processes. Effect of wall thickness on the properties of carbon steel seamless tubing are discussed. Alloy steels, medium manganese, 18 Cr-8 Ni, and 6% Cr, are discussed. Physical properties and applications of these compositions are given. WLC(3)

Iron Castings with Eutectic Structure. (Eisengussstücke mit eutektischen Gefüge.) B. Osann. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 8, 1931, pages 373–380.

The author maintains that good castings have always had eutectic structure but it was not recognized because the conceptions of eutectic and eutectic structure have so far not been defined sharply enough. He shows a way to produce this structure with certainty by properly adapting the amount of Si to the content of C which is desired. The eutectic structure also offers the best machinability and gives a good clean surface. From the tests, a formula is developed, by means of which the tensile strength can be calculated from the chemical analysis. The calculated values agree very well with the results of tests. Ha(3)

Properties of Killed and Rimmed Steel. (Eigenschaften beruhigt und unberuhigt vergossenen Stahls.) W. Oertel & A. Schepers. *Stahl und Eisen*, Vol. 51, June 4, 1931, pages 710–715.

The differences of blowholes and segregations of killed and rimmed steel were studied by microscopic examination and chemical analysis. The change of the physical properties between top and bottom, edge and core was determined for billets (70 mm.^{2}) as well as for finished round bars of 40 mm. diameter and 20 mm. diameter, respectively. In annealing, or recrystallizing, the grain of the rimmed steel grows more rapidly than that of the killed steel. There are also differences as to mechanical and magnetic aging. The rimmed steel seems to tend to aging to a smaller extent than the killed steel. GN(3)

The Growth of Cast Iron under Tension Stress. (Das Wachsen von Gusseisen under Zugbeanspruchung.) E. Piwowarsky & O. Bornhofen. *Archiv für Eisenhüttenwesen*, Vol. 5, Sept. 1931, pages 163–166; *Iron & Coal Trades Review*, Vol. 123, Nov. 6, 1931, page 697; *Foundry Trade Journal*, Vol. 45, Nov. 1931, page 306.

Whereas cast iron in application may show changes of volume even at temperatures above 200° C., laboratory tests showed practically no changes of volume up to 550° C. This was supposed to be due to oscillations cast iron structures and machinery parts are subjected to. The investigation was undertaken to elucidate the above assumption. 6 different cast irons were tested and the effect of an increased load (1 kg./mm.^{2}, 2 kg./mm.^{2}, 3 kg./mm.^{2} and 5 kg./mm.^{2}) upon the elongation was studied in dependence upon the time. The results indicate that (1) the temperature of the beginning growth of cast iron is not essentially decreased when the cast iron is subjected to a tension load; (2) a static elongation is observed at temperatures up to about 500° C. This elongation, however, is not simply indicative of the possible growth; (3) volume changes occur at temperatures above 500° C., which indicate growth. Cast irons which had become completely ferritic by annealing in vacuum show, when subjected to a tension load in vacuum, volume changes independent of the chemical composition. The size of these volume changes are in accordance with the volume changes of steel at the corresponding temperatures. A short time growth test is proposed as follows: A 20 hr. heating at 650° C. and a load of 1 kg./mm.^{2} The extension found with this load and time shall be indicative of the growth. Ha+GN(3)

Investigation of the Heat Sensibility of Low Carbon Steel. (Untersuchung der Ueberhitzungsempfindlichkeit von niedriggekohltem Flussstahl.) E. Pohl, E. Krieger & F. Sauerwald. *Stahl und Eisen*, Vol. 51, Mar. 12, 1931, pages 324–326.

Electrolytic iron, low C steel sheets and one low C-Mo steel sheet were used for the experiments. The sheet samples were heated for one hr. and 5 hrs. at temperatures of 950°, 1000°, 1050°, 1100°, 1150°, 1200°, 1250°, 1300°, 1350° and 1400° C. (for one hr. only) and cooled in air. The Mo steel was subjected only to the 5 hrs. heating. After cooling, the grain size was determined and plotted in diagrams. In electrolytic iron, burning and oxidation starts at 1300° and the heating at 1150° C. for the 5 hrs. heating. The corresponding temperatures for the low carbon steel are: 1350° (1 hr.) and 1250° (5 hrs.). In the Mo steel, burning is observed at 1300° C. Material with a larger grain size is less resistant against burning than one with a fine grain. GN(3)

The Practical Application of New Values for the Judging of Cast Iron. (Ueber die praktische Anwendung neuer Wertbegriffe für die Beurteilung von Gusseisen.) Hans Pinsl. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 1931, pages 334–339; May 1, 1931, 357–363.

For judging the quality of cast iron, Thum and Ude had suggested the use of the ratio σ_B/f = bending strength/deflection, while Meyersberg proposes the bending number 100 × deflection/bending strength $= \dfrac{f \times 100}{\sigma_B}$ and tensile strength × bending number $= \sigma_B \times f \times 100/\sigma_B' = \sigma_B \times Z_f$ = bending product. This latter formula is, however, not intended to give any insight into the texture. The lines of equal bending products are called isoflexes. The formulas were determined on 5 kinds of iron; the relation σ_B/f for the formation of graphite was corroborated. The isoflex-diagram corresponds also to the views obtained with the first named method and offers, therefore, a reliable measure for the quality with regard to bending and tensile strength. If location of the isoflexes is reduced to a standard sample, each kind of casting will then give its own characteristic isoflex-diagram. Ha(3)

High Strength Malleable. (La malléable à haute résistance.) E. Piwowarsky. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 879–884. 14 figures.

General résumé. Average properties of black heart malleable made in different types of furnaces are:

Furnace	Tensile strength lbs./in.^{2}	Elongation % in $2^1/_2$ in.
Cupola	54,000	10.9
Oil Furnace	52,000	12.0
Open Hearth	57,000	11.1
Brackelsberg	61,500	18.1

The General Electric method for rapid annealing is mentioned. The author gives a curve to show that instead of 5 days on the usual cycle, by heating first to about 1075° C. then cooling to about 750° C., and running the temperature up and down from 750° to 770° C. several times, the process can be completed in 1 or 2 days, according to the size of the furnace. Cr alone hinders graphitization. Ni favors it, but Ni alone does not produce an improved malleable. The combination of $2^1/_2$% Ni and $^1/_2$% Cr in alloy heated to 975° C. (for 3 hrs. against 1 hr. for the unalloyed malleable) raised the tensile strength from 88,000–92,000 to 100,000–128,000 lbs./in.^{2}, and dropped the elongation from 2–4% to $^1/_2$–1%. HWG(3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Some Properties of Protective Films on Metals. Ernest S. Hedges. *Journal Society Chemical Industry*, Vol. 50, Jan. 9, 1931, pages 21-25.

The oxidation of metals in the air is determined by 3 factors: (1) the chemical affinity for O, (2) the volatility of the metal and (3) the physical properties of the oxide. In aqueous solutions, corrosion is determined by the solution tension of the metal and the physical and chemical properties of the product. Given a solution tension such that the reaction will start, how far it will proceed will depend to a large extent on the solubility of the product. If readily soluble, the reaction should continue rapidly; if insoluble it may or may not allow further corrosion, depending on whether its physical properties are such as lead to a sufficiently protective film. When a metal is made the anode of an electrolytic cell, it may exhibit more than one type of behavior. (1) It may be unattacked by the liberated ions and lead to the evolution of O. (2) A film of insoluble and poorly-conducting material, practically preventing further passage of current, may form on the metal. (3) The metal may dissolve continuously to form a salt. (4) The metal may dissolve smoothly at low current densities, while with increase of current a film may form. When (4) occurs, the current passing falls and the potential of the anode rises on formation of the film; dissolution of the metal may continue at a slower rate, giving perhaps ions of higher valency, or the metal may become passive, scarcely dissolving at all, while O is freely evolved. Many examples of the factors enumerated for the various exposures of metals are given. VVK(4)

Faraday's Views on Passivity in the Light of Recent Research. Ernest S. Hedges. *Journal Society Chemical Industry*, Vol. 50, Sept. 11, 1931, pages 750-751.

Faraday in 1836 discussed the phenomenon of passivity ascribing it to the production of an oxide film. His discussion contains the fundamental views accepted today although he lacked the experimental substantiation such as the actual separation of the oxide film, etc. The author also gives an excellent brief historical review of passivity. VVK(4)

Correlation of Certain Soil Characteristics with Pipe-Line Corrosion. I. A. Denison. *Bureau of Standards Journal of Research*, Vol. 7, Oct. 1931, pages 631-642; *Oil & Gas Journal*, Vol. 29, June 5, 1930, page T-200.

Corrosion experienced in the operation of a group of pipe lines in Ohio was found to be related to the kinds of soil which occur along a 32-mile section of the lines. Soils of the Brookston series in this area are non-corrosive. Soils of the Nappanee series proved to be corrosive wherever they occurred. The Wauseon soils occurring on slopes or slight ridges were observed to be corrosive. Other sandy and sandy-loam soils not underlain by glacial material apparently have little corrosive action. A satisfactory correlation was found to obtain between the exchangeable H present in the soils and corrosiveness as indicated by the quantity of pipe replaced in 1000-foot intervals. The hydrogen ion concentration of soil samples in normal potassium chloride solution is a fairly satisfactory index to the corrosiveness of the soils studied except in the case of slightly buffered sands. Both methods, however, tend to exaggerate the corrosiveness of well-drained sandy soils. An accelerated laboratory test of soil corrosiveness involving the corrosion of a steel disk in contact with moist soil is described. The results obtained paralleled the quantity of pipe replacements fairly closely in the case of heavy soils. The degree of corrosiveness indicated by the test is influenced by the acidity, texture and probably by the structure of the soils studied. Since only a qualitative study of the factors influencing the test has been made, the test cannot at this time be considered a reliable index of soil corrosiveness except in the case of soils similar to those tested. The methods described for identifying corrosive soils which involve determinations of acidity are probably most reliable in the case of related soils which differ from one another chiefly in their contents of exchangeable H. The data obtained from the tests are probably insufficient to indicate the relative corrosiveness of soils having widely different physical and chemical characteristics. VVK+WAT(4)

Prevention of Valve-Seat Erosion. Edward M. Getzoff. *S.A.E. Journal*, Vol. 29, Oct. 1931, pages 332-335.

A theory for the cause of a thin spotty deposit or pick-up on the valve seat that accelerates erosion is advanced, and this deposit is said to be absent on valve seats made of non-ferrous metals. Al bronze gives satisfactory results but is difficult to secure to cast iron cylinder-blocks because of its greater coefficient of expansion. Several partially successful methods of securing Al-bronze rings to cast iron are shown. A method that is applicable to one alloy which has reduced erosion under the most severe operating condition to such an extent that it is almost negligible is described. (4)

Methods for Testing the Corrosion Resistance of Light Metal Alloy Sheets. Martin Abraham. *Metal Industry*, London, Vol. 39, July 17, 1931, pages 51-53; July 24, 1931, pages 77-79.

Condensed from lecture of Erich K. O. Schmidt, Dr. Ing. before Deutsche Gesellschaft für Metallkunde. Alterations in mechanical properties and microstructure should be taken as main indications of corrosion resistance of a metal. Testing methods used by Deutsche Versuchsanstalt für Luftfahrt are (1) stirring method where the specimen is completely immersed in 3% NaCl solution to which may be added 0.1% H_2O_2 if sheet is Al coated; (2) dipping method where specimen is dipped for 2 min. every hr. in 20% NaCl solution; (3) spraying where specimen is subject to NaCl spray for 10 min. every hr. The thickness of the uncorroded specimen is used as basis for computations. Bend tests and alterations in Erichsen values are sometimes used as additional means of comparison of corrosion resistance of different materials. PRK(4)

Chemical Methods of Treatment of Metals and Alloys to Prevent Corrosion. (Les méthodes purement chimiques le traitement des métaux et alliages contre la corrosion.) J. Cournot & J. Bary. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liège, June 1930, pages 493-498.

Brief mention is made of methods of blueing steel and coloring various alloys. Parkerising and other phosphate treatments are dealt with in more detail. "Protalization," a process of producing an oxide film on Al and its alloys and rendering the oxide coating insoluble, is mentioned but not clearly described. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 3. HWG(4)

Ammonia to Combat Corrosion to Rerun Unit. J. C. Albright. *Refiner & Natural Gas Manufacturer*, Vol. 10, Aug. 1931, pages 71-74.

Ammonia is utilized to give alkaline reaction to the condensate recovered from the pressure distillate processed through it. (4)

On the Attack of the More Common Metals by Phosphoric Acid Solutions. (Sur l'attaque des metaux usuels par les solutions phosphoriques.) A. Portevin & A. Sanfourche. *Comptes Rendus*, Vol. 192, June 15, 1931, pages 1563-1565.

In an article accompanied by 1 diagram, representing the loss in weight in mm./cm.^{2} during a period at most 250 hours, the authors present results of tests on the corrosion of Al, Sb, Bi, Cd, Cu, Fe, Pb, Mg, Ni, Ag, Sn and Zn in phosphoric acid of three different concentrations. The authors arrange the metals in three groups—those readily attacked (of which Mg and Zn are examples), those practically unaffected by the acid (such as Bi and Ag), and those which are affected intermediately in greater or lesser degree. OWE(4)

A Corrosion Tester for Pressure Vessels. Cloyd M. Chapman. *Instruments*, Vol. 4, Oct. 1931, page 527.

A device for testing corrosive action in a pressure vessel is shown, by which a sample of metal in either wire or block form can be pushed into the vessel through a nipple and withdrawn after the proper interval of time without in any way interfering with the operation going on in the vessel. An aluminum yoke with a large hand wheel is attached around a stuffing box. A spindle of stainless steel, with double-lead threads, moved through the stuffing box by turning the hand wheel, carries the sample to be tested for corrodibility at the other end, attached to a porcelain spool. When the sample is drawn back out of the pressure vessel at the end of a test, a gate valve forming part of the instrument, capable of withstanding 400 lb. pressure, is closed. The test metal block or wire can then be taken off and examined. A sample in the form of very fine wire gives returns in the shortest time. Wire of Bessemer steel, pure iron, and some of the alloys can be had in sizes down to 0.003 in. If the sample is in block form, one or more surfaces should be polished. The polish should not be so high as to inhibit corrosion. Three $^1/_2$ in. blocks can be tested at once by insulating with nonmetallic washers and bushing, or more if they are enough smaller. The porcelain spool has 4 sets of notches so that 4 wires may be wound on and tested at once; and there is room for 2 spools to be put on the spindle at once. A pocket microscope giving a magnification of 40 or 50 diameters is very convenient for examining the corroded samples. (4)

The Effect of Hydrogen Ion Concentration on the Corrosion of Tin. J. M. Bryan. *Transactions Faraday Society*, Vol. 27, Sept. 1931, pages 606-620.

In the absence of air, Sn suffers negligible corrosion in citric acid, but in the presence of O, corrosion reaches a maximum at a pH 3.1. Ferrous citrate additions accelerate corrosion. Ferric citrate, even in the absence of O, causes corrosion of Sn in 0.5% citric acid solution. 20 references. PRK(4)

Quay Wall Design and Construction. Louis Beaudry. *Engineering Journal*, Vol. 14, July 1931, pages 394-397.

Various types of quay walls suitable for the severe climatic conditions of eastern Canada are described. Some steel sheet piling, installed 16 yrs. ago by the Harbor Commissioners of Quebec was corroded as follows. The portion of pile above high water and exposed to the atmosphere at all times was dark brown in color and uniformly pitted. The portion of pile submerged at nearly all times was corroded and showed some pocking. The portion of pile buried in the sand showed some pocking at the level of the ground surface but a few ins. below this was in a good state of preservation. The author states, "Although no definite conclusions may be drawn from these isolated tests, the sixteen years of exposure justifies us in saying that the fears entertained as to premature deterioration of the steel wall through corrosion were not well founded. The results of the tests seem also to confirm the statements and findings of other engineers who have studied steel structures which have been exposed for even longer periods. Therefore, we may safely come to the following conclusion, 'steel that is buried in sand or ground, or is submerged in water, is less exposed to damage through corrosion than when exposed to the air.' This conclusion is doubly valuable since the portion of the steel wall which is most subject to corrosion is that portion which can be periodically inspected." Steel quay walls designed for a life of over 40 yrs. may be protected as follows. (a) Provide a cap of reinforced concrete on the top of the wall and fill the space between the upper and the lower wallings so that water will not run directly on the piling. (b) Cover all the surfaces of the steel to be buried with a heavy coating of paint, free from acid and oil, since the acid may cause corrosion and the oil may be saponified within a short period of time. (c) Paint the piles before driving. (d) Use heavier connections on wallings and anchors because when 2 dissimilar metals are placed in contact with each other, riveted or bolted together, there is a tendency for one of the metals to be preserved from corrosion at the expense of the other, which will corrode much more readily in such a case. (e) Use anticorrosive steel such as cupiferous, Ni and Cr steels. VVK(4)

Corrosion Resisting Coatings for Duralumin. H. A. Gardner. *Metal Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1065-1066.

From paper read before the American Society for Testing Materials. See "Notes on Aircraft Finishes," *Metals & Alloys*, Vol. 1, Dec. 1930, page 901. MS(4)

The Colloid Theory of the Corrosion of Iron and Steel. J. Newton Friend. *Transactions Faraday Society*, Vol. 27, Sept. 1931, pages 595-596.

In rapidly moving aerated water, Fe passes slowly into solution and the iron hydroxide is swept away. Under stationary conditions, the Fe passes into solution and the ferrous hydroxide clings to portions of the metallic surface, partially screening it from O and inducing anodic corrosion. Includes discussion. PRK(4)

Formation of Ferrite in the Rusting of Iron. (Bildung von Ferrit während des Rostens von Eisen.) C. Carius. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 197, Apr. 30, 1931, pages 254-256.

Observations on the work by A. Krause and J. Tulecki. Ferrous ferrite corresponding to the formula $Fe(FeO_2)_2$ was prepared by electrolysis of NaCl solution with electrolytic Fe as anode. The black product formed was submitted to X-ray examination and showed a few lines belonging to the magnetite lattice as well as a few faint lines due to the admixture of other oxides. The formation of ferrite is explained as follows: in the acid O-containing solution Fe^{++} ions separated at the anode are completely oxidized to Fe_2O_3, which is positively charged. With continuing electrolysis the pH falls, the Fe_2O_3 becomes negatively charged, Fe^{++} ions are no longer oxidized to Fe_2O_3, and the formation of $Fe(FeO_2)_2$ occurs. Rust which is formed by corrosion of Fe in weakly acidified distilled water shows the same lines on X-ray examination. The X-ray diagram of rust formed by corrosion of Fe in water with pH between 5.5 and 6.5 shows the lines corresponding to γ-FeOOH. (4)

Methods and Apparatus for Corrosion Testing of Metals. (Ueber Methoden und Apparate zur Korrosionsprüfung von Metallen.) G. Gollnow. *Chemische Fabrik*, Vol. 4, Aug. 5, 1931, pages 326-328; 341-342.

A general review of the subject including rapid methods with cuts of apparatus and 28 references. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 19. (4)

Steel Plates Clad with Nickel for Acid Resistance. *Iron Age*, Vol. 128, July 23, 1931, pages 256-258.

Describes Ni steel plates recently developed by the International Nickel Co. and the Lukens Steel Co. used in the construction of heavy containers in which corrosion resistance is a factor. VSP(4)

When Does Oxidation Occur in Oil and Gas Fired Furnaces? *R-S Industrial Heat Review*, No. 31, July 1931, pages 11-12.

Explains briefly the conditions of combustion and temperature to avoid or produce oxidation. Ha(4)

The Corrosion of Iron and Steel. *Engineer*, Vol. 151, May 8, 1931, pages 523-524; May 15, 1931, pages 550-551.

Abstract of report by the Corrosion Committee submitted to the Iron & Steel Institute. See also discussion on page 535-536 and editorial on page 545, May 15, 1931 issue of the *Engineer*. LFM(4)

Corrosion of Various Alloys in Solutions of Phosphoric Acid. (Attaque de divers alliages par les solutions phosphoriques.) A. Sanfourche & A. Portevin. *Comptes Rendus*, Vol. 193, July 6, 1931, pages 53–55.

The authors continue a report of their investigations of the corrosion of metals by phosphoric acid solutions (C.R.192, 1931, p. 1563) by describing an investigation of a series of alloys including: Alpax, containing 13% silicon; Duralumin, containing 3.8% copper; 0.5% magnesium, 0.4% silicon and 0.4% manganese; brasses, containing 60 and 65% copper; bronze, containing 9% tin; cupro-nickel, containing 84, 57 and 27% copper; nickel-silvers, containing 62% copper and 12% nickel, and 65% copper and 5.7% nickel; antimonial lead (7% Sb); and a series of steels of different compositions, including some stainless steels of austenitic and martensitic structure. The results of the tests showed that the alloys of aluminium were readily attacked (losses of 0.0002–0.0005 g./cm.^{2}/hr.), that the alloys of copper were less readily corroded (losses, varying according to the alloy, of 0.0002–0.0004 g./cm.^{2}/hr. in 52° B acid, and from 0.0001 to 0.0002 g./cm.^{2}/hr. in acid of 30° B). It was noted that antimonial lead did not show the same resistance to attack that was observed in the case of pure lead. The results obtained on the steels are shown graphically. As a result of analysis of the corroding media subsequent to the tests, it was discovered that in those steels which were rapidly corroded, the chromium was attacked more readily than the iron, the nickel less than either. In the cupro-nickels the two constituents were dissolved in about the same proportions; the same was true for the brasses, but in the bronze the tin was attacked more than the copper. At the conclusion of the paper reference is made to a series of tests which have been conducted on a group of ferro-alloys, the results of which indicated that only ferro-chromium and ferro-silicon can be considered resistant to the attack of phosphoric acid solutions. OWE(4)

Hydrogen Sulphide Corrosion in Natural Gas Engines. V. L. Maleev. *Power*, Vol. 74, July 28, 1931, pages 127–128.

Gas containing 5% H_2S was quite corrosive until freed from H_2O. Then it could be used without difficulty. (4)

Electrical Conductivity and Tensile Properties of Light Magnesium-Aluminum Alloys as Affected by Atmospheric Exposure. E. Wilson. *Journal Institution Electrical Engineers*, Vol. 69, Dec. 1930, pages 89–94; *Journal Society Chemical Industry*, Vol. 50, March 6, 1931, page 205.

Comparative atmospheric corrosion tests have been made on stressed conductor wires of high-purity aluminum, aldrey, duralumin and a 0.75% nickel-aluminum alloy. The change in resistance with time was least with the nickel alloy and greatest with duralumin; after two years the ratio R_0/R_t was 0.96 for the nickel alloy, 0.93 for aluminum, 0.90 for aldrey and 0.85 for duralumin. Intercrystalline corrosion in the duralumin was very marked, but occurred to only a slight extent in aldrey and not at all in the nickel alloy or aluminum. The loss in weight and the increase in specific resistance were the same for the nickel alloy after exposure for 24 years as for aldrey after exposure for 1.5 years. All four conductors showed an average loss of 7.5% in the breaking load after 9 months, but there was a tendency for the more tightly stressed wires to suffer a smaller decrease in strength than that of similar wire under corrosion was in the elongation, especially in the case of duralumin, which after 8 years failed to show any elongation in the tensile test. (4)

The Corrosion and Protection of Magnesium and Magnesium-Base Alloys. L. Whitby. *Industrial Chemist*, Vol. 7, May 1931, pages 203–206.

44 references. Article is subtitled, "A Survey of Available Information." Attack by aqueous solutions usually results in severe pitting and does not seem to be subject to intercrystalline corrosion. Need for work on corrosion fatigue of Mg alloys cited. Oil and motor fuels containing organic acids or ethyl alcohol are detrimental. Relation between corrosion and microstructure briefly discussed. Effect of certain alloying elements on the corrosion of Mg is discussed. Mn is added to most Mg-base alloys to restrain corrosion. Methods of protection named and briefly discussed are, (1) alloying, (2) electrolytic methods, (3) chemical dipping methods, and (4) paint coatings. RAW(4)

The Development of Railway Water Supply Practice. C. R. Knowles (Illinois Central System). *Journal American Water Works Association*, Vol. 23, Apr. 1931, pages 481–488.

A general account of the various agencies, societies, etc. working on the problem of railway water supplies and corrosion. VVK(4)

Corrosion Prevention. I. By Metal Composition. II. By Protective Coatings. W. S. Johnston. *Power*, Vol. 74, July 28, 1931, pages 121–123; Aug. 4, 1931, pages 155–157.

Loss through corrosion of iron and steel is about 2%/yr. The author discusses common types of corrosion, the use of non-corrosive alloys and of protective coatings. (4)

Corrosion in Ballast Tanks and Tankers. Correspondence from F. C. Martin, Birkenhead, England. *Metal Progress*, Vol. 20, Nov. 1931, page 79.

The attack of tanks for carrying liquid cargoes by the liquids themselves and by sea water that may be used as ballast on return trip is discussed. WLC(4)

The Nature of the Covering Layers Appearing in the Anodic Passivity of Iron in Solutions Containing Sulphate Ions. (Ueber die Natur der Deckschichten, welche bei anodischer Passivierung von Eisen in sulfationhaltigen Lösungen auftreten.) W. J. Müller & W. Machu. *Zeitschrift für physikalische Chemie*, Bodenstein Festband, 1931, pages 687–703.

The authors combine the measurement of the passification time and the observation on the passification process by means of the polarization reflexion microscope and found the following possible types of surface layers causing the passivity of Fe in solutions containing sulphate ions: (1) the natural oxide layer as produced by air; (2) a layer consisting of $FeSO_4 \cdot 7H_2O$ which is found in all acid solutions above 0.5 *N*; (3) an oxide film, not identical with the "natural oxide layer," is formed with potentials over 2 volts. The total SO_4^{--} concentration plays the dominating role, since the same passification occurs in 0.1 *N* H_2SO_4 as well as in 0.1 *N* Na_2SO_4; (4) a porous layer of a basic salt which is formed in diluted SO_4^{--} solutions. EF(4)

The Wear of Metals. Louis Jordan. *Mechanical Engineering*, Vol. 35, Sept. 1931, pages 644–651.

The present paper must at once disclaim any pretense of being the desired adequate presentation of a field at once so broad and so little understood. It attempts only to make some tentative definitions and classifications of various types of wear of metals; to offer a few comments on the possible mechanisms of wear; to indicate rather sketchily the importance of the part played by the wear of metals in engineering design and service; to recall various means that are employed for the lessening of or protection against wear; to discuss the extent to which the testing or research laboratory is able to predict from accelerated tests the relative wear resistance of metals; and, finally, prompted by a suggestion that has been made a number of times both verbally and in the literature, to raise the question as to whether the problem of the wear of metals is of such a nature, magnitude and importance that any formal organization and co-ordination of interested research agencies might bring about more notable progress in furthering knowledge in this field. (4)

Resistance of Aluminum and Aluminum Coated Steel to Oxidation at High Temperature. A. Hauttmann. *Iron Age*, Vol. 127, May 7, 1931, page 1507.

Abstract translation of an article in *Stahl und Eisen*, Jan. 15, 1931. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 165. VSP(4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Further Investigations on the Structure of Phosphate Slags and Its Relation to the Solubility in Citric Acid. (Weitere Untersuchungen über das Kleingefüge verschieden vorbehandelter Phosphatschlacken und seinen Zusammenhang mit der Zitronensäurelöslichkeit.) H. SCHNEIDERHÖHN. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 7, 1931, *Report* 177, pages 109–120; *Archiv für Eisenhüttenwesen*, Vol. 5, July 1931, pages 9–16; *Stahl und Eisen*, Vol. 51, July 16, 1931, pages 917–918.

Report No. 209 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Thomas slags with additions of sand or fluorspar or both together were subjected to various cooling conditions and microscopically examined. The addition of fluorspar causes the disintegration of the silico carnotite ($5CaO \cdot P_2O_5 \cdot SiO_2$) into apatite and calcium ortho silicate. Since silico carnotite has a high solubility in citric acid and apatite is insoluble in this acid, an explanation is found for the poor solubility in citric acid of the slags with additions of fluorspar. Further investigations were made with finished and unfinished open-hearth slags. In this case, a high solubility in citric acid is also due to the presence of silico carnotite. Beside this phosphate, 2 more phosphates of unknown character were microscopically established. The phosphates possess a much smaller solubility in citric acid than the silico carnotite. By adding fluorspar to the open-hearth slags, apatite is formed causing the solubility to be further decreased. The following conclusions are drawn: (1) In all phosphate slags, a high solubility in citric acid is due to the presence of silico carnotite. (2) CaO, SiO_2 and P_2O_5 should be present in the relation $5CaO{:}1\ SiO_2{:}1\ P_2O_5$ in order to form silico carnotite. (3) As to chemistry, structure and solubility in citric acid, all phosphate slags should be divided into silico carnotite slags and apatite slags. (4) Only slags with a normal content of CaO and SiO_2 possess a high solubility in citric acid. (5) Conclusions are drawn upon the practical production of phosphate slags with a high solubility in citric acid. GN(5a)

The Solid Solutions of the Copper-Silver System. D. STOCKDALE. *Engineer*, Vol. 151, Mar. 20, 1931, page 328; *Engineering*, Vol. 131, Mar. 20, 1931, page 382.

Abstract of paper read before the Institute of Metals, Mar. 11, 1931. See *Metals & Alloys*, July 1931, page 128. LFM(5a)

The Ternary System Iron–Sulphur–Carbon. (Ueber das ternäre System Eisen–Schwefel–Kohlenstoff.) R. VOGEL & G. RITZAU. *Archiv für Eisenhüttenwesen*, Vol. 4, May 1931, pages 549–556; *Stahl und Eisen*, Vol. 51, June 25, 1931, pages 793–794.

The partial diagram Fe-Fe_3C-FeS was investigated by thermal analysis and microscopic examination. The previous results by H. Hanemann and A. Schildkötter (*Archiv für Eisenhüttenwesen*, Vol. 3, 1929–30, pages 427–435) were confirmed. The ternary diagram shows a miscibility gap in liquid state that can be determined from the temperature-concentration sections without special chemical investigation. A method is described that permits the determination of one branch of the miscibility gap when the other one is known. The field of primary disintegration must be distinguished in the diagram. It starts even before the beginning crystallization and the adjacent concentration field of the secondary and ternary disintegration, respectively. It results from theoretical considerations that iron sulphide in the shape of fine drops is present even far below the C and S concentration of the actual primary crystallization. Only 3 crystal types crystallize: binary solid solutions of Fe and C, cementite and iron sulphide. The ternary eutectic crystallizes at 975° C. with 0.15% C and 31% S. The amount of cementite in the ternary eutectic is very small. The eutectic is chiefly composed of FeS and the binary solid solution of Fe and C. The disintegration of the solid solutions (formation of ferrite and cementite) and the pearlite temperature is not essentially affected by the S content. The C content in meteoric iron may be the reason for the drop-like shape of the troilite. GN(5a)

The Ternary System Iron–Carbon–Vanadium. (Ueber das ternäre System Eisen-Kohlenstoff-Vanadin.) R. VOGEL & E. MARTIN. *Archiv für Eisenhüttenwesen*, Vol. 4, Apr. 1931, pages 487–495; *Stahl und Eisen*, Vol. 51, June 4, 1931, page 715.

The binary diagram Fe-V was established first within the range of the Fe transformations. The α-γ transformation at 1400° C. decreases up to 1.8% V but increases above this concentration. V increases the temperature of the magnetic transformation at 76.8° C. This transformation could be observed up to 25% V. In the partial diagram Fe-V-V_4C_3-Fe_3C, there exists beside V_4C_3 no other vanadium carbides or double carbides. The α-γ transformation extends over the whole range from the system Fe–C to the system V-V_4C_3 and passes through a minimum temperature. A saturated γ-solid solution with 3.4% C and 6.5% V together with Fe_3C and V_4C_3 forms a ternary eutectic at 1095° C. The eutectic composition is 81.6% Fe, 6.2% C, 12% V. The ternary γ-solid solutions decompose during cooling and form a ferrite phase and a carbide phase with a subsequent formation of pearlite. The decomposition of pearlite of C steels is very much retarded by V, even at low concentrations. On the other hand, V_4C_3 is always rapidly precipitated. The reasons for the increase of hardness of C steels by V are as follows: (1) the increase of hardness of the ferrite phase, (2) the effect on the refining of the pearlite, (3) the precipitation of the extremely hard V_4C_3. GN(5a)

The Ternary System Iron–Phosphorus–Sulphur. (Das ternäre System Eisen–Phosphor–Schwefel.) R. VOGEL & O. DE VRIES. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 613–620; *Stahl und Eisen*, Vol. 51, Aug. 6, 1931, pages 1006–1007.

The paper covers an investigation of the partial diagram Fe-Fe_3P-FeS and establishes a new diagram. GN(5a)

Structure Investigations of Cast Metals and Alloys. (Gefügenuntersuchungen an gegossenen Metallen und Legierungen.) E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 26–29.

The importance of the radially crystallized edge zones is pointed out as greatly influencing the workability of the material. The orientation of the crystals in relation to their velocity of growth should be investigated more thoroughly to be able to explain the origin of the radial edge zones. See *Metals & Alloys*, Vol. 1, Nov. 1929, page 245. Ha(5a)

Standard Micros of High Carbon Steel. HAAKON STYRI & H. O. WALP (SKF Industrie). *Metal Progress*, Vol. 20, Sept. 1931, pages 79, 81, 83.

The authors present a system of standard microphotographs to be used for the metallographic control of heat treatments of high C steels. WLC(5a)

A Critical Study of the Origin of the Banded Structure of a Hot-Worked Hypo-Eutectoid Steel. F. C. THOMPSON & R. WILLOWS (Victoria University of Manchester). *Iron & Steel Institute, Advance Copy* No. 13, Sept. 1931, 26 pages.

35 references. The experimental work and the reasons suggested for banding given by other workers is reviewed. Steel samples were oxidized and heated in CO. After this treatment, it was found that banding did not occur immediately below the decarburized layer. It is concluded that banding is caused by differences in O concentration, and is not affected by P or S concentration gradients. Slag inclusions exert an indirect effect, probably due to the oxides in solution around them. JLG(5a)

The Recrystallization. (Die Rekristallisation.) G. TAMMANN. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.–Sept. 1931, pages 429–436.

Under high degrees of deformation, the crystallites of a metallic coating are lengthened by the sliding of their parts on crystallographically defined planes and directions and the parts are fairly well orientated. In this manner, the elastic, physical and chemical properties are changed because of changes in the atoms. The following property changes, among others, take place: (1) In stretching an iron rod, 5–15% of the stretching energy remains as potential energy in the rod and, under heating, the potential energy is transformed into heat at a temperature interval in which the structure of the hard metal has not yet changed noticeably. (2) The galvanic potential is greatly increased by grinding. (3) The color of certain Au-Ag-Cu alloys becomes yellower by rolling. (4) Cold-working shifts the limits of action to higher percentages of the nobler components. (5) Polonium is precipitated faster by hard Ag and Fe than by soft Ag and Fe. (6) Hg moistens Ag and Cu in the hard state much faster than in the soft state. (7) The dissolving velocity of Fe in acids is considerably greater in the hard than in the soft state. (8) The elastic resistance of a soft tungsten wire is increased by drawing to such an extent that this increase in a regular crystal cannot be ascribed solely to a change in the orientation of its crystallites. (9) Precipitations from over-saturated solid solutions take place with greater velocity in the deformed than in the undeformed state and the precipitations accumulate especially at the slide-lines; this is shown by etching with Fry's reagent. (10) Undeformed rock salt turns yellow by radiation with Ra; deformed salt, black. The tests and experiments made to show these conditions of changed states of crystallites in their various stages and the recrystallization are described. 28 references. Ha(5a)

The Orientation of Rolled Metals of the Hexagonal System. (Ueber die Walztexturen hexagonaler Metalle.) E. SCHMID & G. WASSERMANN. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft XVII, 1931, pages 56–60.

See *Metals & Alloys*, Vol. 2, Jan. 1931, page 5. (5a)

Frontiers of Metallography. (Grenzgebiete der Metallographie.) K. SCHRÖTER. *Zeitschrift für Metallkunde*, Vol. 23, July 1931, pages 197–201.

The application of metallographic methods to the study of tungsten powder and the processes of sintering and recrystallization of tungsten powder is described. The use of metallographic methods in the study of glass is likewise discussed. RFM(5a)

Contributions to the Physics and Metallography of Magnesium. (Beiträge zur Physik und Metallographie des Magnesiums.) E. SCHMID. *Elektrochemische Zeitschrift*, Vol. 37, Aug.–Sept. 1931, pages 447–459.

This is a report of the more recent investigations in the laboratory of the Farbenindustrie A.G. of the physical properties of Mg, the phenomena of plastic deformation and some technically important series of solid solutions of the metal. The physical anisotropy of Mg crystals is explained and the 5 parameters necessary for the characterization of the elastic behavior are determined. The thermal expansion of Mg is almost isotropic. The specific electric resistance of the crystal is given as $\sigma = 3.77 \times 10^{-6}$ ohms/cm., $\sigma\perp = 4.54 \times 10^{-6}$ ohms/cm. The crystallographic characterization of deformations and the dynamic characterization of the basis translation are explained and illustrated by roentgenograms and micrographs. Finally, the formation of α-solid solutions of Al-Mg, Zn-Mg and Mn-Mg are discussed and illustrated and the results of tensile tests are given in the form of curves. 26 references. Ha(5a)

Resistivity of Single Crystal Zinc. E. P. T. TYNDALL & A. G. HOYEM. *Physical Review*, Vol. 38, Aug. 15, 1931, pages 820–827.

Measurements on specific resistance as a function of orientation check the Voigt-Thomson symmetry relation accurately for crystals made from Kahlbaums best Zn. The principal resistivities are: $p_{||} = 6.20^2$ and $p_\perp = 5.86^5 \times 10^{-6}$ ohms/cm.^{3}, with the ratio $p_{||}/p_\perp = 1.057$. For "spectroscopically pure" Zn the majority of the crystals yield consistently the same value of $p_{||}/p_\perp$, with $p_{||}$ and $p_\perp$ each about 0.6% lower than for the Kahlbaum Zn crystals. A few crystals of "S.P." Zn gave anomalous results of a type previously found by Bridgman. The disagreement between the authors' values, particularly the $p_{||}$ and $p_{||}/p_\perp$, and Bridgman's most recent values does not seem explicable in terms of an effort on resistivity of strain, but rather must be ascribed to differences in the crystals caused by some as yet unknown conditions governing the crystal growing process. WAT(5a)

Transformational Characteristics of Iron-Manganese Alloys. HOWARD SCOTT (Westinghouse Elec. & Mfg. Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 435, Sept. 1931, 19 pages.

Transformations were studied by means of a dilatometer. A new transformation occurring in alloys containing between 12 and 20% Mn was detected. In contrast to the A_3 transformation, the new or A_s transformation occurs with an increase in volume on heating and a decrease on cooling. An irreversible contraction on heating was found only in high C alloys that had been cooled rapidly. The effects of various amounts of Ni, Mn and C on the temperature of the beginning of Ar_3 are discussed. 1% Mn is equivalent to 25% Ni and 1% C is equivalent to 18% Ni with respect to the lowering of this temperature. These relationships hold when 5% or more Ni is present, but not so well in the absence of Ni when Ar_3 begins below 300° C. It is suggested that the A_s transformation represents a transformation between the γ-solution and the hexagonal close packed phase designated by Schmidt and Ohman as the epsilon phase. X-ray diffractions did not support this contention. The microstructure was appreciably changed by this transformation, however. The principle of pressure restraint of transformations is discussed. 11 references. JLG(5a)

Influence of Special Elements on the Carbon Content of the Iron-Carbon Eutectoid. EVERETT L. REED (American Sheet and Tin Plate Co.). *American Society for Steel Treating, Preprint* No. 32, 1931, 60 pages, 36 references, 39 micrographs.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931; a condensed report of research conducted as part of the requirements for Doctor of Science degree at Harvard University. The author reports his determinations of the displacements of the eutectoid composition by the addition of increments of 1% of Ni, Mn, Cr, W, Mo, V, Si, Cu, Al, Co, Ti, and U to pure Fe-C alloys of 0.16%, 0.32%, 0.59% and 1.50% C. Melts were made in vacuum and in most cases melted twice. A microscopic analysis of slowly cooled specimens was made and confirmed by determination of the hardening power of the alloy. A study of the segregation in some of the cast specimens is reported. Hypereutectoid Ni and Mn steels were found to be martensitic. Hypereutectoid Cr, W, Mo, and V steels were found to be cementitic. The special elements may be arranged in order of their power to displace the Fe-C eutectoid as V, Mn, Cr, Mo, W, and Ni. Body-centered elements displace the Fe-C equilibrium diagram to the left while face-centered cubic elements, except Ni, displace it to the right. The enlargement or closure of the γ field due to alloys is discussed. Hardness of all steels in the as-cast, annealed, and normalized conditions are reported. A study of spheroidizing in eutectoid steels was made. The effect of the alloys on the critical range is reported. Tensile, Charpy and twisting tests were made on Ni, Cr and Mo steels of eutectoid composition. Mo steel possessed the maximum torsional strength at high temperatures. Cr steel is not strengthened in the blue heat range. WLC(5a)

Thermo Magnetic Analysis and the A_0 Transformation in 0.75% Carbon Steel. R. L. Sanford & G. A. Ellinger (Bureau of Standards). *Preprint* No. 32 for June 1931 meeting, *American Society for Testing Materials*, 11 pages, 5 figures.

In an annealed high carbon steel, a change in magnetization occurs at 150–215° C. (300–420° F.) on heating, usually termed the A_0 transformation, and ascribed to the presence of Fe_3C. A hardened carbon steel shows no trace of A_0. The question arises whether the absence of A_0 proves the absence of Fe_3C in untempered martensitic steel. It has been suggested that the Fe_3C is in too fine a state of sub-division to show A_0. But by progressively spheroidizing the Fe_3C in a 0.75% C, 0.52% Si steel, it was shown that A_0 decreased in intensity and temperature as the size of the Fe_3C particles increased. A_0 occurs in sorbitic steel. It was concluded the absence of A_0 probably indicates absence of carbide, and that untempered martensite probably does not contain Fe_3C. HWG(5a)

The Formation and Decomposition of Cementite. (Sur les conditions de formation et de décomposition de la cémentite.) P. Pingault. *Comptes Rendus*, Vol. 191, Nov. 24, 1930, pages 1007–1008.

Pure cementite, prepared by the action of NaCN upon Fe filings at 650° C., was heated in vacuum at various temperatures and subjected afterward to the attack of HNO_3 (d = 1.2). After 10 hrs. at 1000° C. only faint traces of graphite could be found. After 1 hr. at 1075° C. the cementite was agglomerated and distinct traces of graphite were found. After 1 hr. at 1175° C., the cementite was transformed partly into metallic globules having the microscopic characteristics of gray cast iron and partly into a powder, containing much graphite. Below 1000° C., therefore, the pure cementite may be considered very stable, but as soon as the melting temperature of cast iron is approached, the decomposition of the cementite becomes rapid. In forming cementite from pure Fe and NaCN in the absence of air, it was found that the cementation of the Fe was negligible at a temperature of 600–650° C. and 850–900° C. The same results were obtained in pure and in commercial NaCN. Different results obtained in the presence of air are believed to be due to the carbonizing action of the decomposition products of the NaCN. Soft steel electrodes were immersed in a NaCN bath kept at 650° C. and a current passed through. The effect varies considerably with the current density. After 40 hrs. at 1 amp./$dcm.^2$, the anode was much hardened while the cathode remained unchanged. At 20 amp./$dcm.^2$, there was no hardening of the electrodes, but the anode was corroded. At 60 amp./$dcm.^2$, the loss of weight of the anodes after 15 hrs. amounted to 2.5 gr/$cm.^2$ The powder derived from the decomposed anodes was found to contain 6% C and 2–2.5% O. It consists of cementite detached from the anode on account of the great speed of formation and on account of its fineness—slightly oxidized by the washing media employed. (5a)

Preparation of Graded Abrasives for Metallographic Polishing. J. L. Rodda. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 438, Sept. 1931, 9 pages.

Sized abrasives more suitable than those on the market can be conveniently prepared. Detailed directions are given for the preparation of alumina particles of various sizes. For polishing Zn and its alloys, the following 4 grades of alumina were found to be satisfactory:

Time required to settle 1 in.	Ratio of diameter of largest particle
4 hr.	1
30 min.	2.82
3 min.	8.96
20 sec.	26.8

The coarsest grade is used after grinding with 000 emery paper. Polishing with the 20 sec. grade is usually omitted if the sample is to be etched. Other grades would probably be better suited for metals of other hardness. Commercial alumina is dispersed in a colloid mill, the suspension allowed to settle for a definite time, and the top layer siphoned off. A thorough dispersion is produced by using a small amount of sodium silicate. After separation of the desired emulsions, it is recommended that they be prevented from settling. Micrographs of the abrasives and samples prepared by emulsions separated as described are shown. Contains 4 references. JLG(5a)

On the Coarse Grain Recrystallized Cold Drawn Seamless Steel Tubes. With an Appendix: Annealing Tests on Critically Cold Rolled Low Carbon Steel Bars. (Ueber grobkörnige Rekristallisation Kaltgezogener nahtloser Rohre aus Flussstahl. Mit einem Anhang: Glühversuche mit kritisch kaltgewalzten Stäben aus Kohlenstoffarmem Flussstahl.) A. Pomp & E. Holweg. *Kaiser Wilhelm Institut für Eisenforschund*, Vol. 13, No. 1, 1931, *Report* 171, pages 1–28; *Stahl und Eisen*, Vol. 51, May 7, 1931, pages 595–597.

It is known that the physical properties of cold drawn or cold rolled and annealed low carbon steel (up to 20% C) are impaired when the cold work amounts to from 8% to 16% and the annealing is performed between 600–800° C. Since it was also known that a coarse grain sometimes occurs in recrystallizing cold drawn seamless steel tubes, a study was made to learn if the above laws also hold in manufacturing tubes. The tests on notch toughness and grain size show the following results. The reduction of the cross-section of the tubes always amounted to 10% but the reduction of the wall thickness was 10%, 5% and 0%. The annealing temperatures were between 600° and 920° C. and the annealing times were 10, 30, 60 and 360 mins. The notch toughness decreases in the critical annealing temperature range. A minimum occurs at temperatures between 750° and 800° C. Though it should be expected that a maximum grain size corresponds to the minimum of notch toughness, this is not materialized. With the exception of the 360 mins. annealing, all grain size diagrams show 2 maxima, the one at 700° C. and the other at 800° C. Only the latter one corresponds to a minimum of notch toughness. Therefore, a coarse grain cannot be the only cause of a low notch toughness. Microscopic examinations revealed that the type of pearlite and cementite has an essential bearing upon the notch toughness and it is shown that the notch toughness varies even if the grain size of the samples tested is the same. Low notch toughness can be due to the formation of intersticial cementite. Additional experiments were carried on to elucidate the conditions of the formation of intersticial cementite. GN(5a)

The Constitution of Alloys of Silver and Mercury. A. J. Murphy (National Physical Laboratory). With an Appendix on the X-xay Examination of the System Silver–Mercury by G. D. Preston. *Institute of Metals, Advance Copy* No. 577, Sept. 1931, 21 pages; *Engineer*, Vol. 152, Oct. 2, 1931, page 358.

Alloys throughout the entire series were studied. The Ag-rich alloys were heated above their melting points in sealed quartz tubes in a steel bomb. The pressures developed were as great as 250 atmospheres. Cooling curves were obtained while the alloys cooled in the bomb. Some of the Hg-rich alloys were examined microscopically at sub-atmospheric temperatures. Progressive additions of Hg to Ag produced a continuous lowering of the liquidus down to the melting point of Hg. No alloy has a freezing point below that of Hg. Hg dissolves in Ag to form a solid solution containing up to 55% Hg at 276° C. The solubility of Hg probably decreases at lower temperatures. Two intermediate phases are formed, β, containing 40% Ag, dissociates at 276° C. into a Ag rich solid solution and liquid while γ contains 29–30% Ag and dissociates into β plus liquid at 127° C. An X-ray examination showed that β had a hexagonal close-packed lattice with, a = 2.98 A. U., and c/a = 1.62. γ has a body-centered cubic lattice with a parameter of 10.0 A. U. The effect of pressure on the results obtained is considered, and it is concluded that conditions were not greatly affected by the necessarily high pressures in the Ag-rich alloys. 14 references. LFM+JLG(5)

Structure & X-Ray Analysis (5b)

The Determination of Crystallite Orientation. G. Tammann. *Metal Industry*, London, Vol. 37, Oct. 17, 1930, page 372.

Abstract of paper read at the autumn meeting of the Institute of Metals at Southampton. Describes principal methods for determining the orientation of the crystallites in metals and results of their application to various metals are given. See also *Metals & Alloys*, Vol. 1, Dec. 1930, page 908. VSP(5b)

The Diffraction of Electrons by Single Crystals. G. P. Thomson. *Proceedings Royal Society*, Vol. 133, Sept. 1931, pages 1–25.

Experiments on the diffraction of electrons of 30–50 kilovolts by single crystals of Cu and Ag are described. They show a widely extended pattern of diffraction spots. The usual wave theory can be extended to account for these patterns by supposing that the etched surface is composed of a number of lumps of dimensions of the order of 10^{-6} cm. These may in some cases be the portions left between adjacent etching pits. The nature of the surface prevents any effect of inner potential being detected. A detailed agreement exists between theory and experiment, even in the case of the more irregular "exceptional" patterns, the only discrepancy being probably due to a 2% distortion of the surface lattice in one specimen. No sign was found of reflection by "forbidden" crystal planes or of half-order spectra. Some experiments on Cu electrolytically deposited on single crystals of the same showed: (a) a strong tendency for the deposit to follow the underlying Cu in orientation; (b) a marked difference of spacing (4:45 instead of 3:61) in some cases and the appearance of spots not characteristic of the ordinary face-centered structure of Cu. Diffraction spectra are produced from a cleavage of rocksalt, and also well marked Kikuchi lines. The spectra of different orders are not evenly spaced. This seems to indicate an inner potential of about +10 volts for rocksalt. The depth of penetration of the rays under the conditions of oblique incidence used is about 10^{-7} cm. For both Cu and Ag, the position of the spots and Kikuchi lines is in excellent agreement with the simple theory. In particular, there are no "forbidden" reflections or half-order spectra. In some cases, the Kikuchi lines are represented by blackened strips. The cause of this is not explained. Explanations are suggested for some of the anomalies observed by other workers. WAT(5b)

Measurements of Elasticity with X-Rays. (Elastizitätsmessungen mit Röntgenstrahlen.) G. Sachs & J. Weerts. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft XVIII, 1931, pages 39–45.

See *Metals & Alloys*, Vol. 2, Mar. 1931, page 65. (5b)

X-Ray Determination of the Solubility of Magnesium in Aluminum. (Röntgenographische Bestimmung der Löslichkeit von Magnesium in Aluminium.) E. Schmid & G. Siebel. *Zeitschrift für Metallkunde*, Vol. 23, July 1931, pages 202–204.

The precision X-ray camera devised by Sachs and Weerts (*Zeitschrift für Physik*, Vol. 60, 1930, page 481) was used to determine the solid solubility of Mg in Al. The variation in the side of the unit face-centered unit cube of Al, a_0, with increasing Mg was determined in quenched (from 445° C.) alloys. a_0 varied almost linearly with atomic percent of Mg from 4.41 A. U. in pure Al (Al = 99.83%, Fe = 0.10%, Si = 0.07%) to 4.122 in an alloy with 17.40 atomic percent Mg. The solid solubility of Mg in Al at 445° C. is 16.8 atomic percent Mg, and the increase of a_0 is 0.0047 A. U./atomic percent dissolved Mg. The quenched alloys were reheated to a series of temperatures in order to establish equilibrium. a_0 was determined on these quenched alloys and the solid solubility pertaining to this temperature were read from the curve expressing a_0 as a function of Mg-content. The solid solubility curve determined in this way agreed closely with that determined microscopically by Dix and Keller (*Chemical Abstracts*, Vol. 23, page 2685), but indicated a slightly greater solid solubility at high temperatures and a slightly smaller solubility at low temperatures. RFM(5b)

The Application of X-Rays in Foundries. (Röntgentechniek in het Gieterijbedrijf.) G. B. van Straaten. *De Gieterij*, Vol. 4, Sept. 1930, pages 144–149.

The Metalix-X-ray apparatus made by Philips' Lamp Works (Eindhoven, Holland) is briefly described with its applications in foundry practice. HSvK(5b)

The Knowledge of Atomic States in the Metal Lattice on the Basis of Magnetic Measurements. (Zur Kenntnis der Atomzustände im Metallgitter auf Grund magnetischer Messungen.) E. Vogt. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.–Sept. 1931, pages 460–466.

The author tries to find explanations for the structure of metals and the nature of the metallic state from the magnetism of the metals. His method is particularly to determine the quanta state of the metal atoms in the lattice structure because the quantum theory rests on the exact measurements available from spectroscopic observations. The dependence on temperature which is expressed by the law of Curie shows a certain inexplicable exception in a paramagnetism which is constant at varying temperatures. For this reason, Pauli developed a theory on the basis of Fermi's statistics which yielded, by ascribing to the atom in the metal lattice the same twist or spin as in the free atom, the possibility of calculating this state of magnetism which has so far been without explanation. A great number of tests with alkali and alkali earth metals are described; the curves of these show the soundness of the theory. On this basis, the author tries to elucidate the formation of solid solutions in metallic alloys. The diamagnetic metals, Au-Ag and Au-Cu, are particularly investigated. Their magnetic behavior shows clearly that the atoms in the solution must be in a different quantum state than those in the pure metal; this indicates a definite diamagnetic configuration of the electrons. 33 references. Ha(5b)

Recrystallization of Sheet Aluminum. (Zur Rekristallisation von Aluminiumblech.) E. Schmid & G. Wassermann. *Metallwirtschaft*, Vol. 20, May 22, 1931, pages 409–410.

Contains 4 references. Contrary to previous beliefs the authors show that pure aluminum has a definite cubical structure after recrystallization. X-ray pictures were taken at 3 different angles of 99.74% pure Al which had been annealed for 5 hours at 500° C. The faces of the cubes lie in the plane of rolling and the edges in the direction of rolling. Tensile tests of samples cut at different angles to the direction of rolling show the influence of rolling direction. CEM(5b)

The Casting Texture of Metals & Alloys. (Ueber die Gusstextur von Metallen und Legierungen.) F. C. Nix & E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 10, 1930, pages 79–89.

The casting texture of a series of metals is examined by X-rays. See *Metals & Alloys*, Vol. 1, Mar. 1930, page 427. Ha(5b)

On the Structure, Formation and Decomposition of Martensite. (Om martensitens struktur, bildning och sönderfall.) Einar Oehman. *Jernkontorets Annaler*, Vol. 115, July 1931, pages 325–357.

X-ray investigations with high dispersion focusing cameras have shown that the tetragonal martensite lattice dimensions vary continuously with the C content. This result indicates that the tetragonal martensite is a supersaturated solution of C in α-Fe, and that the C content is the same as that of the austenite from which it forms. The hypothesis is advanced that the structure consists of C_2 groups oriented parallel to the tetragonal axis. This explains the observed density, volume increase with C content and the elongation of one of the crystal axes. Decomposition on tempering takes place continuously with a progressive decrease in the axial ratio. HCD(5b)

Studies on Magnesium and Magnesium Alloys I. (Studien an Magnesium und Magnesium legierungen I.) E. Schiebold & G. Siebel. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 17, 1931, pages 61–70, 27 figures.

X-ray crystallographic examination of Mg single crystals, of the same after deformation, of extruded Mg alloy (6.3% Al 1% Zn), of wire of another alloy (3% Al, 1% Zn) and of rolled pure and alloyed Mg sheet. The slip planes and direction of slip were found to be similar to those in Zn and Cd, i. e., the basal plane (0001) and the diagonal axis $[11\bar{2}0]$. Twinning, as previously pointed out by Mathewson and Phillips, is along the $(10\bar{1}2)$ plane and in some cases also along the $(10\bar{1}1)$ plane. Cold extruded rod and wire show sometimes a fiber structure or a transition, especially on working at higher temperatures, to a ring-fiber structure. On forcing through a cylindrical die, the ring-fiber structure changed to a regular fiber structure. In Mg sheet, the basal plane lay in the rolling plane within the wide variation of 100° C. After recrystallization, the rolling texture shown by pole-figures, was preserved, not being altered by annealing at 550° C. WAT+HWG(5b)

The Spark Spectra of Tellurium—Te IV and TeVI. K. R. Rao. *Proceedings Royal Society*, Vol. 133, Sept. 1931, pages 220–227.

The spark spectra of Te has been examined by means of a vacuum grating spectrograph in the region λ1500 to λ500 with and without inductance; photographs have also been taken with quartz instruments of discharges through Te vapor in capillary tubes. With the aid of these data, the doublet system of Te IV has been identified and a term scheme has been suggested, by applying a Rydberg formula (with 16R constant) to 2 members of each of the sharp and diffuse secondary series. The largest term, $5pP_{1/2}$ = 305,091 cm.$^{-1}$, gives an ionization potential of about 37.7 volts for Te IV. Three pairs with $\Delta\gamma$ = 11,814 cm.$^{-1}$ have also been identified as being the combinations between the deep 5sS, 5pP, 5dD and 6sS terms of Te VI. An approximate term scheme is proposed. The ionization potential is found to be about 72.0 volts. WAT(5b)

Atomic Physics and Metallurgy. (Atomphysik und Metallkunde.) E. Piwowarsky. *Metallwirtschaft*, Vol. 10, Sept. 4, 1931, pages 689–695.

Contains 23 references. A review of recent studies and theories on the use of X-rays in the study of the constitution of metals, the space lattices of the elements, the lattices of solid solutions and chemical compounds, the structure of atoms and explanation of the periodic system of elements, and electron lattices and properties of elements. While the theoretical study along these lines has been helpful to metallurgy and systematic alloying, a number of gaps in the knowledge and prediction of the properties of new alloys still exist. CEM(5b)

X-Rays for Metal Examination. The Significance of Laue-Spectra of Metals. V. E. Pullin. *Journal Institute of Metals*, Vol. 47, Feb. 1931, pages 3–9.

The principle of X-ray examination by a sharply defined beam of monochromatic radiation falling on and penetrating a metallic specimen is explained. Changes which take place in the crystal arrangement show in photographs taken with this beam and, thus, demonstrate clearly any change in the arrangement which is worked by any treatment. A series of micrographs illustrate this for rolling and heating. Ha(5b)

X-Ray Analysis Applied to Detection of Defects in Foundry Practice. (Röntgenologische Erkennungsmöglichkeiten von Gusserzeugungsfehlern in Giessereibetrieben.) H. Reininger. *Giesserei*, Vol. 17, Jan. 17, 1930, pages 63–71.

The advantage of X-ray analysis in foundry practice is set forth. An attempt should be made to apply X-ray examination not only to castings but also to certain cores and molds. (5b)

Non-Destructive Testing by Gamma Rays from Radium. Robert F. Mehl. *Journal American Society Naval Engineers*, Vol. 43, Aug. 1931, pages 371–395.

The article describes the apparatus used by the Naval Research Laboratory and discusses experiments carried out on steel castings. A large number of photographs and radiographs are presented showing the results obtained. It is inevitable that this new method of radiographic inspection should be compared with the X-ray method. This new method offers advantages in greater simplicity of operation, almost complete portability, far greater penetration, and more satisfactory performance on irregular sections. It suffers from the rather longer exposure times and from the lack of general availability of radium. The cost of an inspection method is naturally of very great interest to industry and before it can be claimed this new method will have a wide application, it will be necessary to show that its costs are not prohibitive. Such surveys as have been outlined in this paper, however, indicate that a sensible prosecution of the method industrially should result in costs which are well within the admitted range of inspection costs. It is of interest to note that the Navy has considered the matter carefully and has decided to provide the Navy Yards on the east coast with radium for this purpose. This radium will be held at the Naval Research Laboratory. The total amount will be one-half gram divided into 3 portions so that separate portions can be sent to the various Yards as required. WAT(5b)

The Reflection of Long X-Rays. C. B. O. Mohr. *Proceedings Royal Society*, Vol. 133, Sept. 1931, pages 292–303.

The refraction indices of long X-rays are investigated by the total reflection method, using a vacuum spectrograph, and the characteristic X-rays isolated by either a crystal or ruled grating. The critical angles were determined for quartz, calcite, steel, glass, Ag and Au at 8.32 A. U. (Al $K\alpha$), and for quartz, glass and steel at 13.3 A. U. (Cu $L\alpha$), and compared with the values given by the classical Drude-Lorentz dispersion formula. For the light mirrors, quartz, calcite and glass, agreement was found within the limits of experimental error between the observed and calculated values of the critical angle, and for the rate of fall of intensity of reflection near the critical angle. For the denser mirrors, steel, Ag and Au, however, increasing large discrepancies were found to occur with increasing density of the reflector. WAT(5b)

Scattering of High Velocity Electrons by Thin Foils. H. V. Neher. *Physical Review*, Vol. 38, Oct. 1, 1931, pages 1321–1341.

With a narrow, homogeneous beam of electrons, scattering by thin foils of Al, Ag and Au, has been investigated. Voltages up to 145 kv. (β = 0.63) were used. Comparison of values of scattering for Al, Ag and Au shows that ρ increases faster than Z^2. For Al, the dependence found experimentally agrees well with either Mott's or Rutherford's equation. The latter also gives the correct dependence on angle for Au and Ag. Mott's equation is not applicable for these heavy elements. Absolute values for scattering for Al compared with theory give ρ = 1.32 of the value given by Mott's equation. This relation is valid within the ranges θ = 95°–173°, V = 56–145 kv. Secondary electrons coming from the foil are distributed according to the simple cosine law. No evidence of loss of energy due to radiation is found up to one-half the energy of the primary beam. WAT(5b)

The Periodic System of Atomic Nuclei and the Principle of the Regularity and Continuity of Series. William D. Harkins. *Physical Review*, Vol. 38, Oct. 1931, pages 1270–1288.

New relations which concern the existence and stability of atomic nuclei are presented, together with a discussion of evidence for the relations given earlier as exhibited by the newer data on the existence of isotopes. It is shown that the 4 series, He, U, Li and Be, exhibit a considerable amount of regularity and are now almost continuous. WAT(5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Magnetic Methods of Testing Butt Welds. T. R. WATTS (Westinghouse Elec. & Mfg. Co.). *Preprint, American Society for Testing Materials,* Mar. 1931, 14 pages.

Shop-testing of butt welds may be done by magnetizing the welded specimen and sifting on iron powder. Serious faults are shown by an accumulation of the powder over the bad spot. For permanent record, Van Dyke paper is laid over the weld, iron powder sprinkled on and an arc light used to print the pattern of the powder. Defects may be obscured through the roughness of the weld. A portable weld-test meter, which is a simple permeameter, is used to span the weld. Comparison of readings across the weld with those on the material welded indicate the quality of the weld. Such tests on a series of welds ranging from completely welded down to those with only 10% of fusion, are plotted to show good correlation with the results of tensile tests. Another type of test meter contains a stationary bar of steel of high permeability (hypernik) and a movable bar of the same connected to a pointer. When a welded piece is magnetized, and this tester placed over the weld, the flux density is affected by imperfections in the weld and the pointer is correspondingly deflected. If the readings on the parent metal each side of a weld average 0.82 and the weld reads 1.5, and the calibration chart shows that for 0.82 parent metal a perfect weld should read 1.2, then the weld has a magnetic efficiency of 1.2/1.5 = 80%. These magnetic methods plus visual inspection are claimed to detect most faults of any consequence in a butt weld. See also *Metals & Alloys,* Vol. 2, Feb. 1931, page 36. HWG(6)

Determining Results of Abuse in Advance. R. G. ROSHONG & U. A. WHITAKER. *Machine Design,* Vol. 3, Aug. 1931, pages 31–34.

Description of accelerated tests to determine the wear in Hoover vacuum cleaners. Ha(6)

The Resistance to Wear of Carbon Steels. SAMUEL J. ROSENBERG (U. S. Bureau of Standards). *American Society for Steel Treating, Preprint* No. 7, 1931, 18 pages.

Paper read and discussed at the Boston Convention of the Society in Sept. 1931. Illustrated by 31 photomicrographs and numerous curves; 5 references to the literature are cited. The author presents the results of tests of C steels in the Amsler wear testing machine under combined rolling and sliding friction and heavy pressures. Annealed C steels gave relatively poor resistance. Normalized steels showed low resistance greatly improved with increase in the C content. The hardened steels showed low wear resistance in the lowest C ranges but as the C increased, the wear resistance increased rapidly to about 0.6% C and then very slowly with further increase in the C content. Tempering lowered the resistance. Martensitic-troostitic structure gave the best resistance. Lamellar pearlite in normalized steels gave nearly as good results as hardened condition. Spheroidal cementite gives poor resistance. This type of wear results in marked distortion of the material adjacent to the wearing surface. WLC(6)

The Right Amount of Metal in the Right Place. F. W. SLANTZ. *Product Engineering,* Vol. 2, Sept. 1931, pages 385–389.

Structures of such shape that the stresses cannot be analyzed mathematically require laboratory determinations Even then, the best design with regard to stresses will result in a defective product if its proportions cause difficulty in producing an article with sound metal throughout, free from residual stresses. Impact resistance increases with yielding and uniformity of stress distribution; but excess metal causes increased stiffness and wide stress variations. Hence, the necessity for accurate stress determination for structures subject to dynamic loads. Methods for making tests and arranging the instruments at the proper places are described and a few examples of properly laid out designs illustrated. Ha(6)

Hardness of Chromium as Determined by Vickers-Brinell, Bierbaum and Mohs Methods. RICHARD SCHNEIDEWIND. *American Society for Steel Treating, Preprint* No. 2, 1931.

Paper presented before the Boston Convention of the Society, Sept. 1931. 18 references to the literature are made. Hardness results on Cr plate, Cr plate subjected to various treatments, and annealed cast Cr are given. Curves showing the relation between various methods of hardness determination are given. WLC(6)

Stretching of Gold-Silver Single Crystals. (Zugversuche an Gold-Silberkristallen.) G. SACHS & J. WEERTS. *Mitteilungen der deutschen Materialprüfungsanstalten,* Sonderheft 13, 1930, pages 120–128; *Zeitschrift für Physik,* Vol. 62, 1930, pages 473–493.

The critical gliding force (single crystal yield point) is at a maximum at 50 atomic % (35.5% Ag by weight). Some comments are given on the pure metals Au, Ag and Cu. Cu single crystals harden up on deformation twice as much as Au or Ag. The addition of one of these elements to the other in solid solution produces, in single crystals, a raising of the elastic limit, which also becomes more clearly defined, a raising of the hardening up to a greater amount of slip, and an increased dissymmetry of the process of slip. HWG(6)

Nick-Break Testing Methods. (Kritische Untersuchung des Schlag-Kerb-Faltversuchs nach Kr K 100, hinsichtlich seiner Eignung zur Prüfung der Kerbzähigkeit von blankgezogenen Werkstoffen.) F. SAEFTEL & H. RUDOLPH. *Mitteilungen aus den Forschungsanstalten des Gutehoffnungshütte Konzerns,* Vol. 1, Feb. 1931, pages 61–66; *Automobiltechnische Zeitschrift,* Vol. 33, 1930, page 492.

According to a German specification, a cold drawn steel specimen is sawed half way through with a 2 to 2½ mm. saw cut, gripped in a vise level with the cut, and hit with a hammer. The specimen must bend at least 30° before fracture and the fracture must be matt-gray. The effect of a sharp and a dull saw, of a cut 2 mm. wide and one 2½ mm. wide, and of the point at which the specimen is hit with the hammer was examined. It is shown that these variables so greatly affect the test that it is useless and should be displaced by a properly carried out notched bar impact test on a pendulum machine. HWG(6)

Fabrication of Rails. (La Fabrication des rails de chemins de fer.) L. PERSOZ. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Apr. 1931, pages 166–178.

Complete discussion of making rails based on studies made by O. Pilz, H. Meyer & W. Schaeffer (see "Comparative Investigations of Rails with Water-Hardened Surface," *Metals & Alloys,* Vol. 2, Apr. 1931, page 80). Si steel is much preferred for use in Austria in making rails. GTM(6)

The Penetration of Electro-Magnetic Waves into Highly Saturated Iron. (Das Eindringen elektromagnetischer Wellen in hochgesättigtes Eisen.) F. OLLENDORFF (Technische Hochschule Berlin). *Zeitschrift für technische Physik,* Vol. 12, Jan. 1931, pages 39–50.

This theoretical paper pertains to the penetration of electromagnetic waves into highly saturated Fe and particularly considers the variations in permeability. The losses due to hysteresis are disregarded in ingot iron and taken into account in approximation in cast iron. EF(6)

The Flow and Fracture of Aluminum under Prolonged Loading. D. HANSON & M. A. WHEELER. *Rolling Mill Journal,* Vol. 5, Mar. 1931, page 208.

Abstract of a paper presented before the British Institute of Metals, Mar. 11, 1931, at London. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 144. JN(6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A. S. T. M. Research Committee on Fatigue of Metals.

Damping Ability of Ferrous and Non-Ferrous Metals in Repeated-Torsional and Repeated-Bending Tests. (Die Dämpfungsfähigkeit von Eisen- u. Nichteisenmetallen bei Dreh- und Biegeschwingungs-Beanspruchung.) J. Schmidt. *Mitteilungen des Wöhler-Instituts*, No. 9, 1931, 52 pages. 39 figures, 8 references.

Damping of a number of alloys was compared, using both the Föppl-Buseman torsion machine and the Föppl-Heydekampf-Wazau repeated bending apparatus. On the latter, the damping was evaluated by determining the use of temperature of the specimen. The ratio of the damping ability in torsion to that in bending ran from 0.52 to 0.60 except for Electron metal, in which it fell to 0.35. This is ascribed to a change in damping properties taking place as the test progresses. The ratio of torsion endurance limit to endurance limit in repeated bending was also determined and found to run from 0.45 to 0.77. On steels of 50,000–130,000 lbs./in.^{2} tensile strength, it varied from 0.52 to 0.68. Endurance tests were run for 2 million cycles, then the stress raised and another 2 million cycle run made, and so on till fracture occurred. Although leaded bronze, phosphor nickel bronze, Al and electron were studied, no runs were continued over 2 million cycles. This small number of cycles in endurance tests of such materials, and the probability of strengthening by understressing during the test, make the endurance figures of little value, according to the abstractor's point of view, for accurate determination of this ratio. The author concludes that the ratio of damping ability and of endurance limit under torsion and bending are characteristic constants of the different materials. HWG(6f)

Detection of Cracks and the Starting of Fatigue Fractures. (Das Feststellen von Rissbildung und des Beginnens von Dauerbrüchen.) Fr. Hirschfeld. *Automobiltechnische Zeitschrift*, Vol. 34, Oct. 10, 1931, pages 639–640.

The importance of the detection of hair cracks and the finest fissures in parts which are subject to fatigue stress, such as the front axles of automobiles, is noted. These fine cracks are bound to lead to fracture in time. One method places the part to be tested in warm oil for some time, cleans it thoroughly with benzine and paints it with lime. If cracks are there, oil spots will show in the white color at these spots. Another test, which does not require so much time, consists in placing the part between 2 electromagnets and strewing iron fillings on it; these arrange themselves in a known manner in the magnetic field. After the current has been cut off, the filings are wiped away with petroleum; but the filings stick at the cracks, so that a thorough examination can be made here. Ha(6f)

Maximum Stress, Its Influence on Cost and Service Life of a Structure. E. Chapman. *Industry & Welding*, Vol. 2, Oct. 1931, pages 25–32.

From the *Journal American Welding Society*. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 306. Ha(6f)

Breakage of Rolls. *Metallurgist*, July 1931, pages 103–107.

An extended abstract of "Fatigue Stresses with Special Reference to the Breakage of Rolls" by F. Bacon, *Proceedings South Wales Institution Engineers*, Vol. 47, Apr. 1931, 114 pages. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. VVK(6f)

Endurance of the High-Strength Construction Steel No. 52. (Zur Frage der Dauerfestigkeit des hochwertigen Baustahles St. 52.) H. Buchholtz & E. H. Schulz. *Mitteilungen aus dem Forschungs-Institut der Vereinigte Stahlwerke Aktiengesellschaft*, Dortmund, Vol. 2, No. 6, 1931, pages 97–112.

See *Metals & Alloys*, Vol. 2, Dec. 1931, page 306. HWG(6f)

The Effects of Rapidly Acting Stress. J. J. Guest. *Proceedings Institution Mechanical Engineers*, No. 5, 1930, pages 1273–1304.

With discussion. Experiments were made to determine the cause of failures under modern stress actions, especially if connected with a large number of repetitions of the action. The method of the author's tests and the apparatus used are fully described. He concludes that the stress which is the important one in design (that at which steel begins to receive permanent effects) is very little affected by the suddenness or the brief duration of the loading and that any higher stresses reached in an impact are due to the internal viscous action and are accompanied by permanent effects dependent upon the stress duration. Ha(6f)

Effect of Surface Decarburization on Fatigue Properties of Steel. C. R. Austin (Westinghouse Elec. & Mfg. Co.). *Metals & Alloys*, Vol. 2, Sept. 1931, pages 117–119.

Six references are cited. A 0.38% C steel with 1.50% Mn was used for these tests. 2 sets of 6 specimens, one only slightly over size and other machined to size were treated under identical conditions in wet H to decarburize the surface and then normalized in H to prevent injury to the surface. The over size specimens were turned to size removing the decarburization and the others finished as to surface without removing an appreciable amount of material. A microscopic examination showed the desired decarburization (0.010 inch) had been obtained. Rockwell and tensile tests show the material to be uniform. The fatigue limit was shown to be decreased from 47,000 lb./in.^{2} to 38,000 lb./in.^{2} due to the presence of 0.010 in. depth of decarburization on the surface of this steel in the normalized condition. WLC(6f)

Some American Researches on the Fatigue of Metals. *Metallurgist*, Nov. 1930, pages 170–172; Dec. 1930, pages 183–186.

A review. VVK(6f)

Electro-dynamic Oscillating Devices for Testing Transmission. (Elektrodynamische Schwingungseinrichtungen zur Prüfung von Leitungsseilen.) A. v. Engel. *Siemens-Zeitschrift*, Vol. 11, Nov. 1931, pages 489–494.

The electro-dynamic method offers the advantage of being able to test the oscillating body under any condition of oscillation. The current can be transmitted to it by flexible leads connected at the nodes. In this way, transmission wires, ropes, hollow cables have been investigated for the number of oscillations at definite amplitude of the oscillation, frequency of current and pre-tension until fracture occurred. The energies necessary to excite oscillation are discussed theoretically and equipment for the production of a wide variation of the frequency for the excitation of the electromagnets used for the maintenance of the oscillations is described. Ha(6f)

On the Torsional Oscillations of Iron Wire. A. G. Hill. *London, Edinburgh and Dublin Philosophical Magazine and Journal of Science*, Series 7, Vol. 12, Aug. 1931, pages 566–572.

The influence of the diameter of the wire on the amplitude of torsional oscillations was investigated. In the equation $y^n(x-a)=b$ representing the extent of the oscillation y, the constants a, b and n were determined and represented in curves. Ha(6f)

A Seven-ton 50 Cycle Fatigue Testing Machine. B. P. Haigh & T. S. Robertson. *Proceedings American Society for Testing Materials*, Vol. 31, Part 2, 1931, pages 221–235.

Description of a larger model of the Haigh endurance testing machine than that previously available. HWG(6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Researches on Silver Plating. E. B. Sanigar. *Monthly Review, American Electroplaters' Society*, Vol. 18, Mar. 1931, pages 26–30.

While the silver bath is easy to work and easy to control, the chemical equilibria in the solution must be quite complex, and no complete theory explaining the deposition of silver from the double cyanide solution has yet been put forward. Nevertheless the author presented brief theories and reported practical results in agreement therewith, obtained recently in England, from which country he had just come. MFB(7a)

Developments in Low pH Nickel Plating. W. M. Phillips. *Metal Industry*, N. Y., Vol. 29, Oct. 1931, pages 433–435.

Paper from the *Monthly Review of the American Electroplaters' Society*, Sept. 1931. Includes discussion. Hard Ni deposits are obtained by plating at low pH values at temperatures around 100° F. A graph is given showing variation of quality of plate with changes in temperature, current density and pH. See also *Metals & Alloys*, Vol. 1, Dec. 1930, page 911. PRK(7a)

Metallography for the Welder. (Metallographie für den Schweisser.) Karl Tewes. *Oberflächentechnik*, Vol. 7, Nov. 18, 1930, pages 211–212; Dec. 2, 1930, pages 221–223.

A short treatise on the problems and methods of metallography and the preparation of samples for examination; the diagrams and photomicrographs are explained. Ha(7a)

Explanation of the Mechanism of Electrolysis and Electroplating. M. de Kay Thompson. *Metal Cleaning & Finishing*, Vol. 2, Oct. 1930, pages 833–836; Nov. 1930, pages 949–952, 968.

Non-mathematical discussion of the mechanism of electrolysis, conducting power of solutions, factors determining which of several ions will be deposited, electrochemical equivalent, different forms of metal deposits, and protection afforded by plating. See "A Model to Explain the Mechanism of Electrolysis," *Metals & Alloys*, Vol. 1, Sept. 1930, page 741. MS(7a)

On the Effect of Mercury in Zinc Cyanide Plating Solutions. M. deK. Thompson & W. E. Charles. *Preprint, Transactions Electrochemical Society*, Vol. 60, Sept. 1931, pages 89–93.

Hg in cyanide zinc plating baths makes the deposit possible at voltages appreciably lower than when Hg is absent. Measurement of electrode potentials in the cyanide solution show Zn with 2% Hg has a less negative potential than straight Zn. H overvoltage on cast iron is lower than on steel, but there is no definite relationship between H overvoltage and C content of the steel. At a current density higher than 2 amp./dm.^{2}, both Zn and Hg-Zn polarize the deposition of H. LCP(7a)

Electrodeposition of Iron, Copper and Nickel Alloys from Cyanide Solutions. Part I. L. E. Stout & C. L. Faust. *Preprint, Transactions Electrochemical Society*, Vol. 60, Sept. 1931, pages 173–198.

Ternary alloys of Cu, Ni and Fe are produced by electrodeposition from complex cyanide solutions. These alloy deposits are bright and vary in color from copper-bronze to platinum-white, as the composition changes from Cu-rich to Ni-rich or Fe-rich varieties. Cu content of the deposit may vary from 45 to 94%, Ni content from 5 to 42% and Fe content from 0 to 26%, while the Cu content of the bath varies from 0.0025 to 0.05 *N*., Ni content from 0.15 to 0.165 *N*., and Fe content from 0.325 to 0.475 *N*. The total metal content of the bath was 0.5 *N*. in all cases. The current efficiency ranges approximately from 0.1 to 35% at current densities of 1.5 to 10 amp./dm.^{2}, 2 to 10 volts, and 25 to 70° C. Platinum cathodes and duriron anodes were used. The bath was made of $K_4Fe(CN)_6$, $KCu(CN)_2$, $K_2Ni(CN)_4$, potassium tartrate, equivalent to 14 g./l. tartaric acid, and free potassium cyanide, 0.5 g./l., but no free caustic alkali. The Cu in deposit is always higher than that in the bath, Fe in deposit is always lower than that in the bath. Higher current densities tend to suppress copper deposition and promote nickel and iron deposition. Temperature has little effect except upon cathode efficiency which is somewhat favored by high temperatures. In order to deposit any Fe at all with Cu and Ni, the bath must contain tartrate and practically no free cyanide. LCP(7a)

Plating of Iron and Steel Castings with Cadmium. (Das Plattieren von Eisen- und Stahlguss mit Kadmium.) E. T. Richards. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, June 26, 1931, pages 516–518.

The plating with Cd offers great advantages over plating with Zn. Among the advantages claimed are: Solubility potential of Cd is higher than that of Fe but lower than that of Zn, so that an equal amount of plated Cd offers a considerably better protection against corrosion than Zn. The chemical reaction of Cd is lower and it, therefore, is more resistant to the action of alkalies and acids. Cd coatings are thinner and give sharper contours and are, for this reason, better suited for precision work. The degree of adhesion of Cd on Fe is much greater than that of Zn and, therefore, the tendency to spall and scale is less. The color of plated Cd, similar to Ag, is more pleasing than that of Zn. The preparation of pieces is described and 3 of the most widely used bath compositions are given. The costs are not prohibitive although they are, at present, higher than for Zn. Ha(7a)

The Finishing of Metal Wares by Electroplating with Silver and Gold. (Die Veredelung der Metallwaren durch die galvanische Versilberung und Vergoldung.) K. Schuch. *Oberflächentechnik*, Vol. 8, Sept. 16, 1931, pages 195–199.

The method usually used at present for both silver and gold is the cyanide bath. Recipes for the composition of the electrolytes and the preparation of the salts are given. Defects are discussed and remedies described. Sometimes the contact method of depositing metal is applied by dipping the objects in a solution or boiling them in it. The respective salt solutions are also given. Methods for recovering gold and silver residues are described. Ha(7a)

Spotting Out. August G. Hoffman. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, page 382.

To prevent spotting out on bronze plated iron castings, they were doubly rinsed in hot and cold water, then dried at 180° F., and dropped into cold water; this process is repeated 3–5 times. PRK(7a)

Modern Processes of Nickel Plating and Chrome Plating. (Les procedes modernes de nickelage et de chromages.) *L'Industrie Electrique*, Vol. 40, Oct. 25, 1931, pages 469–475.

The general principles of the electro-deposition of Ni and Cr are explained and the methods of high-speed plating are discussed. The difficulties encountered, especially the maintenance of the acidity of the baths, the avoiding of the Ni electrode becoming passive and the influence of the temperature of the bath are treated in detail. Ha(7a)

Electro-Depositions on Aluminum. (Elektrolytische Niederschläge auf Aluminium.) M. Ballay. *Deutsche Motorzeitschrift*, Vol. 8, August 1931, page 294.

Difficulties involved in the electroplating of Al and recent performances (Cu, Ag, Cd, Au, etc.) of overcoming those difficulties by utilizing an intermediate layer of Ni. Solution used: iron chloride containing a small quantity of HCl. Most suitable temperature: 90–100° C. Prevention of hydrolysis is by a further addition of tartaric acid. The analyses of the alloys employed are given. Bending tests were performed to study the electroplated samples. Composition of solution most recommended: 6–22 g. Fe/0.1–0.7 Mol HCl/liter. See also *Metals & Alloys*, Vol. 2, Nov. 1931, page 259. EF(7a)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Galvanizing. W. H. Spowers. *Wire & Wire Products*, Vol. 6, Sept. 1931, pages 360–361, 372–373.

Relates to the progress made in using the wash-zinc-chloride technique instead of the hydrochloric flux; the dross reduction obtained by the former method is appreciable. Another progressive step concerns the open hearth where the tight bonding method is recommended for producing a fully Si-killed steel without any Al. Ha(8)

Advancements in Galvanizing Machine Drives. R. J. Wean (Wean Engineering Co.). *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 135–136, 139.

Recent improvements in galvanizing machine drive design have entirely eliminated chatter in the final coating rolls and increased the efficiency of speed adjustment. The author describes and illustrates 3 types of drives for accurately adjusting the speed of finishing rolls. JN(8)

Higher the Dross, Heavier the Coating. W. G. Imhoff. *Heat Treating & Forging*, Vol. 16, Oct. 1930, pages 1289–1291.

The author discusses the relationship that exists between the dross production and the weight of the coating in galvanizing practice. The difference of the Fe content in zinc, especially of new and old, often furnishes a cause for higher losses. Ha(8)

Determination of Thickness and Quality of the Zinc Coating on Galvanized Iron. (Détermination de l'épaisseur et de la qualité des dépots protecteurs sur le fer galvanisé.) R. Vondracek. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 547–553. 3 figures, 15 references.

Gasometric determination of rate of solution of the Zn in H_2SO_4 is recommended. Typical rate curves for hot dipped, electroplated and sherardized coatings are shown. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 217. HWG(8)

Formation of Hard Zinc by Iron Salts. (Hartzinkbildung und Eisensalze.) K. Taussig. *Stahl und Eisen*, Vol. 51, July 9, 1931, pages 885–886.

Experiments show that iron salts which adhere to steels to be pickled, disintegrate when they come in contact with Zn and the iron thus formed combines with the Zn to form hard Zn. In Zn coating, therefore, careful cleaning and the addition of a sufficient amount of inhibitors is of importance. GN(8)

Factors Affecting Galvanizing Pot Life. Wallace G. Imhoff. *Heat Treating & Forging*, Vol. 17, May 1931, pages 465–467, 474.

The corrosive action of molten Zn on the steel side of the pot is fairly slow up to 860° F. but increases rapidly above 900° F. The bath temperature together with production put through the pot in unit time and the volume of the pot determine the life of a pot. These conditions are discussed in detail. A few examples of proper relationship of these factors are discussed. Ha(8)

Wire Galvanizing Process. G. K. Rylands. *Wire & Wire Products*, Vol. 6, Aug. 1931, pages 328–332, 344.

This article takes issue with the views presented previously by Whitehead in favor of the electro-galvanizing process. See *Metals & Alloys*, Vol. 2, June 1931, page 113. Ha(8)

Homogenous Lead-Coating with the Oxy-Acetylene Flame. (Das homogene Verbleien mit der Sauerstoff-Azetylen-Flamme.) R. Salelles. *Schmelzschweissung*, Vol. 10, Aug. 1931, pages 208–209; *Revue de la Soudure Autogène*, 1931, pages 2050–2053.

To obtain an intimate contact of a Pb coating on metallic containers, especially of steel, an intermediate layer of Sn and Pb is applied first; the Pb is melted on this by the flame. The steel is first cleaned by pickling with hydrochloric acid with subsequent thorough rinsing. Instructions for the proper procedure are given and a few examples are described. Ha(8)

Electro-Galvanizing. L. D. Whitehead. *Wire & Wire Products*, Vol. 6, Oct. 1931, pages 396–401.

In this article, the discussion of hot galvanizing is brought to a conclusion in which the author sums up all arguments in favor of the electro-galvanizing method. The coat of Zn so obtained is the purest obtainable. The purity extends far into the inner layers, which is a feature which other galvanizing methods do not obtain. Ha(8)

Surface Improvement of Silver Wares. (Die Oberflächenveredlung von Silberwaren.) H. Moser & E. Raub. *Korrosion und Metallschutz*, Vol. 7, June 1931, pages 134–139.

Experiments were carried out with an 83.5/16.5 Ag-Cu alloy with the object of enriching the Hg content at the surface; its commercial necessity is fully considered. A surface rich in Ag was secured by electro-deposition on one set, by a pickling method in a second set of samples and by a combined pickling and annealing process of a third group. The macroscopic changes at the surface of all specimens during the subsequent brushing with fine brass brushes and the final polishing treatment are noted. Mechanical polishing almost entirely removes the silver film, in contrast with polishing by hand. The surface finish on the electro-plated samples (10 min., 20° C., 0.3 amp/dm.^{2}) could, however, be rendered permanent and effective if the surface was given a polishing treatment previous to the galvanizing process. The surface stability was tested by submerging the specimens in a 1/100 N Na-sulphide solution for 30 secs. These pickling tests yielded the same results as the microscopic examination, i. e., the superiority of (1) hand polishing to mechanical polishing methods and (2) the coating by electro-deposition to the pickling process owing to the rather thin silver-rich surface layer of the latter. EF(8)

Developments in the Tinplate Industry. W. Charles Wright. *Iron & Steel Industry & British Foundryman*, Vol. 4, May 1931, pages 271–272, 284.

An address. CHL(8)

Hot Dipping to Inhibit Corrosion. L. K. Wright. *American Machinist*, Vol. 74, Jan. 8, 1931, pages 58–59.

Brief review of coating methods. Dipping is more satisfactory for intricate designs. Cleaning may be done by sand blasting or pickling. Gives temperature and solution for pickling. Cd melts at 970° F., Zn at 786° F. A Zn bath should run from 900° to 950° F. and parts to be plated should remain in bath for several minutes after bubbling ceases. Dipping is more costly than some methods but more effective. RHP(8)

Wire Galvanizing Processes. IV. Geoffrey K. Rylands. *Wire & Wire Products*, Vol. 6, Dec. 1931, pages 474–476, 486–488.

In this installment, issue is taken with a correspondent. It is maintained that hot galvanizing can give just as good and uniform results as electro-galvanizing. The testimony of microphotographs, that aim to show the superior bonding of the coat with the material by the electrical method, are considered. The decision is that they do not give a proper view of the matter. Ha(8)

INDUSTRIAL USES & APPLICATIONS (9)

The Use of Light Metals for Fire Engines. (Die Einführung des Leichtmetalles bei der Feuerwehr.) Schänker. *Automobiltechnische Zeitschrift*, Vol. 34, Apr. 30, 1931, pages 284–285.

According to the author, fire engines under his supervision have been reduced considerably in weight by the substitution of aluminum for auto-body steel sheets, for castings—silumin, for shapes—lautal, for structural parts of ladder—duralumin, lautal and silumin. Fireman's tools and engine appliances (tubes, couplings, deluge set, spanners, etc.) have also been made from light metal. The new engine pump weighs 2530 kg. and a 24 m. ladder, 3083 kg. less than the previous one. ER(9)

Turbo-Generator Fans. W. Sharp. *Engineering*, Vol. 131, Feb. 27, 1931, pages 292–293.

Brief article describing and giving diagrams of the various types of fans in general use. For smaller designs, fan plates and blades may be made of boiler plate having an ultimate tensile strength of 35–40 tons/in.^{2} For larger units, Ni steel is used for the blades and the plates are made from solid rolled and flattened steel sheets. For high-speed fans, Vibrac V. 30 steel is recommended. This steel has a yield point of 30 tons/in.^{2}, a high maximum stress as well as excellent elongation and reduction of area and is free from temper-brittleness. Its composition is: C, 0.3; Si, 0.15; Mn, 0.6; P, 0.03; S, 0.035; Ni, 2.5; Cr, 0.6; Mo, 0.6%. LFM(9)

Service Conditions and Quality Control of Rails for the Belgian Railways. (Les rails sur le réseau des chemins de fer Belges, leurs conditions de service et le controle de leur qualité.) J. Servais. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session Liege, June 1930, pages 389–403.

Rail service in Belgium, as in other countries, is of increasing severity. Rail steel must be sound, not fragile, and sufficiently resistant to wear. Testing for soundness and freedom from segregation is described. A 25% crop is specified, and 30% usually necessary. Impact strength has been increased by lowering the finishing temperature. On tracks in heavy service rails from the bottom of the ingot have given best results. It would be desirable to know more about the O content of rails and its relation to fragility. Raising C too high increases brittleness and favors the formation of transverse fissures. American practice is criticized and 0.50% C advised as upper limit. With this, 0.85 to 1.15% Mn is used. Raising Mn to 1$^1/_2$ or 2% does not sufficiently answer the question of wear, but is applicable in some cases. Alloying with Ni and Cr is probably too expensive for general use. Electric rails are being introduced and give marked promise. Heat-treated rails will probably be required. Fissures met in Belgian practice generally start at the surface, due to cracking from cold work, rather than at the interior. Use of long rails is advisable. HWG(9)

Production and Use of Crushed Blast Furnace Slag for Building Purposes. (Gewinnung und Verwendung der Hochofenstückenschlacke für Bauzwecke.) Schuler. *Revue Technique Luxembourgeoise*, Vol. 23, Mar.-Apr. 1931, pages 70–76.

Only acid blast furnace slags with a large percentage of silica and little Ca are used as they come from the production of Thomas iron and steel iron. The preparation, binding and additional materials, the requirements for a good slag material are explained. It should have approximately the following composition: 30–32% SiO_2, 12–16% Al_2O_3, 40–42% CaO, 4–6% MgO, 2–3% MnO, 1–1.5% FeO, 1.5% CaS, 0.12% P. The mechanical properties, with particular regard to road building, are equal to those of the best building materials, such as Syenit, Dyorit and all secondary rocks. Ha(9)

The Use of Non-Ferrous Metals in Boiler Construction. (Apparate-Maschinen- und Armaturenbau, Fabrikanlagen, Verwendung von Nichteisenmetallen im Dampffassbau.) H. Scheffel. *Apparatebau*, Vol. 41, Aug. 23, 1929, pages 193–196.

A discussion of copper, nickel and aluminum when used in boiler construction. See *Metals & Alloys*, Vol. 1, July 1930, page 631. WHB(9)

Applicability of Cupal for Contacts. (Die Verwendbarkeit von Cupal für Kontaktzwecke.) H. Schmitt & B. Wulff. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 262–265.

Cupal is a rolled product with a core of Al onto which a thin layer of Cu is rolled on one side or on both sides. Tests for contact resistance have shown that this material is well suited for terminal connectors, clamps, etc. Ha(9)

The Application of Aluminum in Electric Science. (Die Verwendung des Aluminiums in der Elektrotechnik.) H. Schmitt. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 253–260.

To-day, Al is used in some fields of electrical industry with great success; in Germany, for instance, more than 50% of the length of transmission lines for voltages from 30 to 200 KV are of Al. Its particular advantages over Cu are good mechanical properties together with its low specific weight, in particular the ratio of tensile strength to density which is, for the high-conductive, refinable Al alloys, considerably greater than for Cu. Furthermore, the low melting point and the ability to pour easily which, in certain cases, permits the Al to be cast directly into the slots of electrical machines without injury to the iron laminations. The insulating oxide film formed by the material itself is also an advantage. A few examples of these properties which are used in various fields are described and illustrated. Ha(9)

Aluminum Castings in the Electrical Industry. (Aluminiumguss in der Elektro-Industrie.) Schaumann. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 284–292.

Numerous illustrations of parts for electrical machines and apparatus. Ha(9)

Small Sky Cars Entirely of Metal. William B. Stout. *Metal Progress*, Vol. 20, Sept. 1931, pages 40–43.

Describes small metal plane developed for the "average man" who wants to fly his own plane. WLC(9)

The Construction Development of Welded Parts in Steel Construction. (Beiträge zur konstruktiven Gestaltung von geschweissten Verbindungen im Stahlhochbau.) R. Ulbricht. *Stahl und Eisen*, Vol. 51, Feb. 26, 1931, pages 253–257.

Report 169 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The article reviews the latest developments in welding structural parts in building construction and notes the saving of money and time effected by the application of suitably rolled and shaped profiles. A new sheet beam is described. The advantages of welded constructions in comparison with riveted constructions are pointed out. GN(9)

The Construction of Laminated Poles. C. L. Szalanczy. *Metal Stampings*, Vol. 4, Feb. 1931, pages 145–148, 166.

Szalanczy divides the fabrication of stamped pole laminations into a sequence of 8 operations, 2 of which are considered here. First, he describes the spot welding of end plates and the special fixture employed in that operation. Then, he discusses the assembling and riveting operation for building up the laminations and end plates into a complete unit. An adjustable fixture used in a power press is fully described, which rivets one side of the pole at a time. A hydraulic press with interchangeable sets of inserts for larger pole assemblies is also described in detail. This press rivets both sides of the pole in one operation. JN(9)

Rope Strands for Long Suspension Span. D. B. STINEMAN. *Proceedings American Society of Civil Engineers*, Vol. 1, Sept. 1931, pages 1087–1091.
Crossing the Willamette River near its junction with the Columbia, the St. Johns Bridge, a 4 lane highway structure with a main span of 1027 ft., is the longest of any type west of Detroit. As to clear height, also, 205 ft., above navigable water, it sets a high record for under-clearance. Furthermore, it is the longest rope-strand suspension span in the world; all of the 8 longer ones are of the conventional parallel-wire construction. At the Trenton plant of the John A. Roebling's Sons Co., each of the 182 rope strands was manufactured to a length of about 2750 ft., Each strand was then pre-stressed to a total tension of 150,000 lbs. (one half of the ultimate strength) and held at this tension one half hr. The tension was then reduced to 70,000 lbs., corresponding to the average full dead-lead stress per strand in the structure. At this tension of 70,000 lbs., the strand was carefully measured to a calculated length, which varied somewhat according to its position in the cable. Corrections for temperature were included in this measurement. The strand was then cut and socketed, wound on a wooden reel, and shipped by boat to the site. The weight of each strand was 6$^1/_2$ tons. The 182 rope strands, each 1$^1/_2$ inches in diameter, have a total weight of nearly 1200 tons. For each cable, 91 twisted strands form a hexagon. This was filled out to a cylindrical section with segmental strips before the outside wrapping was applied. The hexagon cable had a major diameter of 11 galvanized rope strands (each 1$^1/_2$ inches in diameter) or 16$^1/_2$ inches before wrapping. This was given 2 coats of paint and then the segmented fillers were applied. The fillers consisted of Port Oxford cedar, cut into segmental strips 6 ft. long and treated by immersion for 20 min. in linseed oil at 200° F. When practically all the dead load was on the suspension, the cables, rounded out with the treated cedar fillers, were given their outside wrapping of No. 9 soft annealed double-galvanized wire. The structure cost $4,000,000, a saving of $42,000 over a parallel-wire design. WAT(9)

Arc Welding in Building Construction. P. N. VINTHER (Dallas Power & Light Co.). *Electrical Engineering*, Vol. 50, Oct. 1931, pages 785–787.
Data obtained during the construction of the tallest building erected to date using the electric arc welding process are discussed briefly. Outstanding advantages are: (1) almost complete absence of noise and (2) reduced steel tonnage required. WHB(9)

The Manufacture of Cast Iron Loud Speaker Horns. (Die Fabrikation von gusseisernen Lautsprechertrichtern.) W. SCHAEFER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 10, 1931, page 304.
For quantity production, horns with the narrow part of cast iron of 3 mm. wall-thickness to which the wide part of sheet iron is fastened, proved to assure cheap production as well as good tone quality. Ha(9)

The Construction of Sea-Going Vessels by Electric Welding. GEORGE THURSTON. *Welder*, Vol. 3, Sept. 1931, pages 4–7.
The noted author points out in this article that the use of electric welding in ship building is progressing from day to day, particularly because of the impression which the small battleship, Deutschland, has made which proves that this method is entirely workable even for vessels of large tonnage and subject to severe stresses. The matter is discussed from the viewpoint of confidence in welding which does not yet exist generally but which should be deepened by further experiments; especially from the point of the workmen in the trade unions in England. Their strict distinctions of class of work not to be trespassed on by other men make it difficult to introduce electric welding. Ha(9)

A Tungsten Filament Alloyed with Thorium for Incandescent Electric Lamps. KWAN NISHIMOTO. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 24, 1931, pages 1–36.
The W-Th alloy is a solid solution. AHE(9)

Roller Bearings for Air Service. J. B. NEALEY. *American Machinist*, Vol. 74, Mar. 26, 1931, pages 491–492.
Bearing cages are made of duralumin. Steel for races and rollers is Swedish steel with 1.40–1.65% Cr, 0.025% maximum P, 0.02% maximum S. Describes heat treatment giving temperatures used. Treatment gives cages tensile strength of 62,000 lb./in.^{2}, yield point 30,000–36,000 lb./in.^{2}, and elongation 18–25% in 2 in. Brinell hardness 93–100. RHP(9)

Getting the Most Out of Die Castings. L. H. MORIN (Doehler Die Casting Co.). *Iron Age*, Vol. 128, Aug. 6, 1931, pages 376–377, 398.
The many uses of die castings to date have not exhausted the possibilities of this process in the mechanical field. Gives examples suggestive of the many possibilities of die cast machine elements. VSP(9)

Aluminum in the Construction of Large Current Condensers. (Aluminium im Starkstromkondensatorenbau.) L. LUX. *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 261–262.
Up to 600 volts, condensers can be built up from Al foil with paper or oxide film dielectric. Ha(9)

Nickel in Rails. (Le nickel dans le chemins de fer.) F. RENAUD. *Aciers Speciaux, Métaux et Alliages*, Vol. 6, Apr. 1931, pages 179–189.
General discussion of use of Ni in railroad materials as well as in high Ni steels. European and American Ni steels used for railroads are compared. Mo is also added to a 2% Ni steel. GTM(9)

Operation of High Pressure Boilers. WM. F. RYAN. *Power Notes*, Vol. 17, Sept.-Oct. 1931, pages 1–5.
The article discusses, in general, the problems arising in the operation of high pressure steam boilers. One of the foremost among these is the feedwater purification to avoid troublesome formation of scale. The evaporator has very largely solved this question. Corrosion and embrittlement have been corrected by de-aerators and proper design of boilers; this has also taken care of the combination of pressure and temperature stress. False water levels are often due to incorrect bottom connection for the water column; it should always be so arranged as to drain toward the drum. Gage glasses should be of a good grade of glass and so mounted that it may expand without undue restriction. Ha(9)

Preparation and Properties of Carbide & Nitride Crucibles, with Comments on the Reactions of Carbides & Graphite with Metal Oxides. (Ueber die Darstellung und die Eigenschaften von Karbid- und Nitridtiegeln nebst einem Beitrag über die Reaktionen von Karbiden und Graphit mit Metalloxyden.) O. MEYER. Doktor-Ingenieur dissertation. Technische Hochschule, Aachen, July 1929, 30 pages.
Various Cr-C and Cr-C-Fe, Mo-C and Mo-C-Fe, W-C, Cr-W-C, mixtures were made up, and crucibles made of them; also, of SiC and Ti N. The attack upon these crucibles of molten Fe, Ni, Co, Mn, Cu, Al, Fe_2O_3, MnO, $2FeO \cdot SiO_2$, SiO_2, CaO : SiO_2, basic open-hearth and blast furnace slags, and a soda-lime glass, was studied. The carbide crucibles were attacked by the metals except Cu. The TiN crucible was not attacked by the metals, but was strongly attacked by the oxides. Fe_2O_3 attacked all the crucibles. The other oxides showed no attack on molybdenum carbide crucibles. Nothing was found in which the metals and the oxides could be simultaneously melted. HWG(9)

Steel Arches for Mines. SYDNEY C. MIFFLEN. *Iron & Steel of Canada*, Vol. 14, June 1931, pages 102–103.
An article, accompanied by 2 photographs, in which the steel arches used in colliery practice are described; particulars are given of the materials employed in their fabrication. OWE(9)

Fabrication of Automobile Springs. (Fabbricazione moderna delle molle a balestra per auto.) A. OREFFICE. *La Metallurgia Italiana*, Vol. 23, Sept. 1931, pages 833–836. 3 figures.
Brief mention of composition and properties of common spring steels, with photos of automatic heat-treating furnaces and controls. HWG(9)

One-Material Planes. CHAS. F. MCREYNOLDS. *Product Engineering*, Vol. 2, July 1931, page 319.
This passenger and mail plane is built up of flat sheet Alclad duralumin and is assembled by riveting. The shell is built by riveting together a number of longitudinal gores, all exactly alike and riveted to a series of lateral duralumin rings. The use of only one material reduces manufacturing cost. A few performance data are added. Ha(9)

Bi-metal Pistons. (Zweimetall-Kolben.) MAHLE. *Automobiltechnische Zeitschrift*, Vol. 34, Mar. 31, 1931, pages 205–208.
Under the designation of bi-metal pistons, the author includes only those in which the head is of one material, usually aluminum alloy, and the stem of another, usually cast iron or steel. He sets forth the reasons that gave rise to such constructions and describes about 20 different pistons of this type. "Why have these pistons not gained a foothold in the automotive industry in any country?" the author asks. He finds his answer in an analysis of the present aluminum piston, which he asserts has overcome the defects of the early light-alloy piston. These defects, unduly high thermal expansion and low wear resistance, having been obviated, the reason for the bi-metal piston no longer exists. WHB(9)

Novel and Interesting Tin Roof. K. G. LUNDIN. *Sheet Metal Worker*, Vol. 22, Aug. 21, 1931, pages 482–483.
Description of laying a tin roof of 150 × 76 ft. with sheets of 20 × 28 in. Work had to be done at a temperature of 97° F. Ha(9)

New Materials Will Cut Locomotive Repair Costs. C. A. BARBA. *Railway Mechanical Engineer*, Vol. 105, Oct. 1931, pages 483–487.
The author suggests that, instead of designing to take up wear, the attempt be made to eliminate it by using the special alloyed steels (especially nitrided steels) for repair work. The nitriding process is explained and its possible uses, particularly for locomotive parts, are discussed. Ha(9)

The Technique of Copper Roofing in Germany. (La technique des toitures en cuivre en Allemagne.) H. KUNITZ. *Cuivre et Laiton*, Vol. 4, July 15, 1931, pages 305–313; July 30, 1931, pages 327–331; Aug. 15, 1931, pages 353–355.
Details of connection of the copper sheets to walls, chimneys, gutters, etc., are given. The last installment describes the mounting and fastening of sheets, gutters, window sills. Profusely illustrated. Ha(9)

Casting Large Marine Propellers. WESLEY LAMBERT. *Metal Industry*, London, Vol. 38, May 8, 1931, page 480.
Specifications for large propellers requiring strengths of 40 tons in.^{2} are met by using manganese bronze. The β phase is preferred for propellers on ocean going vessels. PRK(9)

Latticed Metal. (Gittermetal.) CARL KRÖMER. *Maschinenkonstrukteur-Betriebstechnik*, Vol. 64, July 10, 1931, page 160.
In as much as the recent development of bearing metals has produced a solution by the introduction of latticed metals containing graphite, very satisfactory results have been obtained. The castings referred to are of the improved type, cast at 300° C., have a dimension of 0.2 mm. and have clean, smooth surfaces. MAB(9)

Application of Acid-Proof Materials in the Manufacture of Artificial Silk. (Anwendung säurebeständiger Werkstoffe in der Kunstseidenfabrik.) E. WURTZ. *Korrosion und Metallschutz*, Vol. 6, June 25, 1931, pages 21–23.
In the manufacture of artificial silk from viscose, the machines are subject to rapid corrosion by contact with acids or acid vapors. As hardly any material will stand up for a long time, a new non-metallic material by the name of Haveg has been developed by the Säureschutzgesellschaft in Berlin. It has a phenol basis like bakelite. It is readily machinable and can be brought into almost any shape. Another material is Aeterna of the Heddernheimer Kupferwerke, Frankfurt a.M. It is a bronze of very fine grain and a tensile strength of 75–88 kg./mm.^{2} at 200° C. It has a good resistance against sea water and sulphuric acid. Another material for similar purposes is called Thermisilid, made by Krupp, Essen, in several qualities which are resistant against hot lyes, nitric acid, ammonia, hydrogen peroxide and acetic acid. Also the silumin, an alloy with 13% Si of the Metallgesellschaft, Frankfurt a.M. is a good resisting material in the production of artificial silk. Ha(9)

1930 Airplane Design. *Aviation*, Vol. 30, Jan. 1931, pages 22–25.
All performance gains are due to aerodynamic refinement and decreased structural weight. Trend is toward the use of metal. Metal fuselage construction compared favorably in weight with present wooden structures. Riveted Al alloy is used. Stainless steel with electric spot welding is progressing. DTR(9)

Fabricating Heavy Electrical Plant. *Industrial Gases*, Vol. 12, Mar. 1931, pages 20–21.
Adoption of fabricated design in place of castings for parts of large electrical machines has come to fore. Electric arc, oxy-acetylene and gas welding are all used. Automatic oxy-acetylene shape cutting machines are described. DTR(9)

Aluminium in the Construction of Furniture. *Metal Industry*, London, Vol. 38, May 1, 1931, pages 457–458, 460; May 15, 1931, pages 507–508.
Aluminum furniture is distinguished because of its lightness, strength, durability, cleanliness and incombustibility. PRK(9)

Industrial Uses for Tungsten Plate. *Technology Review*, Vol. 33, July 1931, pages 454–455.
The discovery of a process by which a great variety of metals may be electropiated with W has been announced by Prof. Colin G. Fink of Columbia University. The advantages are that it has a high lustre, does not tarnish, has a high melting point, undergoes no appreciable oxidation at ordinary temperature and is resistant to acids. It is of great value to the chemical industries for resistance to heat and acids. MAB(9)

Light Metals for Bus-Chassis. (Leichtmetall für Omnibusaufbauten.) M. KÜHNAST. *Deutsche Motorzeitschrift*, Vol. 8, June 1931, pages 208–210.
The drawbacks of wood, steel and a combination of both for the overhead structure of busses are critically discussed and the utilization of duralumin yielding a saving in weight of about 40% is given. The complete design of a leading German bus manufacturing company is outlined. EF(9)

Bearing-Metals and Repair Work on Bearings. (Ueber Lagermetalle und Lagerreparaturen.) K. HAASE. *Deutsche Motorzeitschift*, Vol. 8, June 1931, page 226.
Controversial remarks on a paper by Schüler (*Deutsche Motorzeitschrift*, Vol. 8, No. 4, Apr. 1931, pages 146–148). The author advocates the usefulness of bearing metals containing lead and graphite, respectively, and states his own experience on repair methods. EF(9)

HEAT TREATMENT (10)

Precautions in Heat Treating High Speed Steel. *Houghton's Black & White*, Vol. 4, July 1931, pages 15–19.
The proper treatment of high speed steels, especially type 18–4–1, in forging, annealing, hardening and tempering is described in detail. Ha(10)

Effect of Heat Treating Firebox Plate and Flues in the Process of Manufacture. *Boiler Maker*, Vol. 30, Feb. 1930, pages 51–53.
Committee report of Master Boiler Makers' Association concerning relative merits of cold-drawn and hot-finished tubes; the conclusion is drawn that hot-finished tubes are more satisfactory for boiler and service. VVK(10)

Heat-Treating Terminology. *American Machinist*, Vol. 74, Jan. 29, 1931, page 219.
Definitions especially related to the ferrous alloys abstracted from the American Society for Steel Treating Handbook. They cover heat treatment, quenching, hardening, annealing, carburizing, case hardening, case, core and cyaniding. RHP(10)

Correct Heat Treatment Essential in Brass Forging and Hot Pressing. R. E. Falk. *Fuels & Furnaces*, Vol. 9, May 1931, pages 591–598.
The practice of forging and hot pressing, the proper sequence of operations, the correct heat treatment and temperature control are discussed fully and furnaces used in the work are described. Ha(10)

Dimensional Changes in High Speed Steel and Furnace Atmosphere. Correspondence from J. E. Hines (C. I. Hayes, Inc.). *Metals & Alloys*, Vol. 2, Sept. 1931, page 119.
The writer presents data indicating tentatively an effect on dimensional changes due to appearance of O_2 in the atmosphere. WLC(10)

The Mechanical Surface Treatment in the Manufacture of Automobiles. (Einiges aus der mechanischen Oberflächenbehandlung im Automobilbau.) Guido Prachtl. *Automobiltechnische Zeitschrift*, Vol. 34, Sept. 20, 1931, pages 575–579; Sept. 30, 1931, pages 610–611; Oct. 10, 1931, pages 634–636; Oct. 20, 1931, pages 663–665; Nov. 10, 1931, pages 711–712.
Numerous examples illustrate hardening, nitriding, carburization plants for parts of automobiles, the changes brought about by the various treatments are illustrated in diagrams for hardness, penetration depth, temperature of treatment. Polishing and grinding for tight fit and the equipment of several plants are described. Ha(10)

Flexibility in Heat Treating. *American Machinist*, Vol. 74, May 28, 1931, pages 818–820.
An installation which serves for carburizing and heat treating and can also be adapted for nitriding is described. Ha(10)

The Heat Treatment and Manufacture of Springs. E. F. Davis. *Fuels & Furnaces*, Vol. 9, Apr. 1931, pages 417–428; May 1931, pages 571–576.
The various kinds of steel used for helical and leaf springs, their chemical and physical properties, the processes of heat treating and annealing, alloy spring steels and defects in spring wire are discussed fully and tables of practical figures are given. In designing springs, the factor of safety should not be under 3; 5 or more is even better. The maximum fiber stress should never exceed 70,000 lbs./in.^{2}; for larger diameter wire, this should be reduced to 50,000–60,000 lbs./in.^{2} Ha(10)

The Heat Treatment and Manufacture of Automotive Shafts and Axles. E. F. Davis. *Fuels & Furnaces*, Vol. 9, June 1931, pages 663–669; July 1931, pages 807–812, 830; Aug. 1931, pages 905–910, 936.
The materials used and the processing and correct heat treatment for the desired physical characteristics are discussed. Ha(10)

Annealing (10b)

The Heat Treatment of Brass. H. M. St. John. *Fuels & Furnaces*, Vol. 9, July 1931, pages 787–794, 838.
The interrelation of the grain structure of brass and heat treatment and the relation between time and temperature annealing is discussed and the means of producing a suitable grain size are described. The rolling practice, the types of heating methods employed, the finishing processes and bright annealing are fully treated. Bright annealing can now be done successfully in a methanol atmosphere but the brass must be allowed to cool below its scaling temperature before it is quenched or exposed to air. The advantages obtained by bright annealing for further use are noted. Ha(10b)

Effect of Normalizing on Sheet Steel. Wm. F. McGarrity & H. V. Anderson. *Fuels & Furnaces*, Vol. 9, Oct. 1931, pages 1169–1170.
Investigation of the effect of normalizing on the properties and grain structure of automobile sheet steel as revealed by X-ray diffraction patterns, photomicrographs and Erichsen-tests gave the following results: (1) Increased soaking time allows the atomic planes to orient themselves into their normal alignment in the space lattice, thereby eliminating internal strain. The grain growth is slight. (2) An increased preheating period has no effect on the crystal structure. (3) Directional properties are not entirely eliminated even with a soaking time of 7 mins. at 1800° F. (4) No lattice dimensional changes take place from the heat treatment. (5) The length of the edge of the unit cube of Fe is found to be 2.89 A. U., corresponding favorably with the accepted value of 2.87 A. U. (6) A temperature of 1700–1750° F. is found to be most favorable for normalizing operations. Ha(10b)

Composition, Temperature, Time and Control Govern Short Anneal. Edwin Bremer. *Foundry*, Vol. 59, Sept. 1, 1931, pages 54–56, 58.
Discussion of results obtained by various investigators. From tests made by Diller, it appears that if composition is correct, the only thing essential to annealing is the heat. In commercial practice, the cycle has been modified to take into consideration such factors as variations in section thickness of castings, variations in composition of metal to be annealed, enlarged size of furnace and large mass of castings to be annealed in the furnace. The overhead electric furnace, rectangular in shape, is used. Uniformity of temperature in all parts of the furnace is essential so that all castings attain maximum temperature in the shortest time. Chemical composition also has considerable effect on shortening of the annealing cycle. VSP(10b)

A. G. A. Research in Bright Annealing Metals. R. J. Cowan. *American Gas Association Monthly*, Vol. 13, May 1931, pages 200, 201, 215.
The object of the research has been to devise ways of annealing metals in a gaseous atmosphere and still retain a bright surface. Distinction is made between those cases where the usual reducing gas may be used and those where definite chemical reactions must take place at the metal surface. The latter case is complicated by the fact that gases are evolved from metals when heated which are oxidizing to the metal, and in Zn bearing metals by the fact that Zn is highly volatile. Even in neutral or reducing gases the metal will be tarnished. The methanol process is described. It has been found that flue gas is unsuitable for bright annealing because of the high content of CO_2. However, if flue gas be made a carrier for methanol vapor and brought into an annealing chamber, the vapors, in dissociating under heat will react with the metal oxides and this reaction will take place regardless of the presence of certain other oxidizing gases. Photographs are given of a typical furnace installation for carrying on this process. RJC(10b)

Age-hardening in Carbon Steels Quenched below A_1 Point. R. YAMADA & K. YOKOYAMA. *Kinzoku no Kenkyu*, Sept. 1931, pages 480–495.

Rockwell hardness, tensile strength, elongation and contraction of area as well as electrical resistance and density were measured with C steels containing various percentage of C from 0.013 up to 0.9% which were quenched below A_1 point, aged at room temperature and tempered at various temperatures. The results of experiments are summarized as follows: Age-hardening in C steels quenched below A_1 point is closely related to the change of the solubility of C in α-iron below A_1 point. The increase in hardness is greater in low C steels than in high C steels. In 0.1% C steel, the increase of hardness is 30%. By quenching from 700° C., and 60% by aging at room temperature, as compared to an annealed state. (58.0% in the annealed state, 78.4% in the quenched state, 94.3% after aging for 330 hrs. in Rockwell B scale.) The change in tensile strength is nearly the same as in hardness. The hardness thus increased diminishes by tempering first rapidly and then slowly. Electrical resistance increases by aging; but decreases by tempering. Density increases only slightly. The age-hardening is explained in the following way: During aging at room temperature, C atoms in steel quenched below A_1 points move toward certain points within the lattice and thus concentrate themselves; this assemblage of C atoms causes the distortion of iron lattice and therefore the hardening of steels. By tempering, cementite molecules separate out in the boundary layers and above 250° C. the formation of its space lattice takes place, these processes resulting in the softening of the steel. KT(10f)

On the Aging of Hardened Carbon Steel. (Ueber die Alterung des gehärteten Kohlenstoffstahles.) S. STEINBERG & W. SUBOW. *Stahl und Eisen*, Vol. 51, July 16, 1931, pages 911–913.

After considering the results of previous investigations on the above subject, the authors report the findings of their own investigations which were carried on with a steel of C, 0.98%; Si, 0.19%; Mn, 0.43%; P, 0.026%; S, 0.01%. Machined specimens of this steel were quenched from 750° C. in water of room temperature and aged at room temperature, 75°, 100° and 125° C. for various times. In all cases, the hardness increased by aging. The increase of hardness is followed by a contraction. For practical purposes, it is suggested that water-quenched steel be aged for 1/2 hr. at 125° C. Hardness and toughness are increased while the internal stresses are diminished. GN(10f)

The Aging of Soft Steel after Deformation at 600°–700° C. (Die Alterung von weichem Flussstahl nach Verformungen bei 600° bis 700° C.) F. SAUERWALD. *Stahl und Eisen*, Vol. 51, Sept. 10, 1931, pages 1150–1151.

In order to study the above noted fact, a "notch-upsetting test" was made on a 0.1% C open hearth and a 0.1% Thomas steel. Both steels were known to show pronounced aging effects and were aged for various times after the deformation had been performed at temperatures between 600° and 700° C. The notch toughness was tested with a 10 mkg. Charpy tester. The results are as follows:

Material	Deformation temperature ° C	Time of aging	Notch toughness mkg./cm.² (room temperature)
Thomas steel	600	20 min.	4.3
		4 hrs.	4.1
		1 wk.	2.9
		3 mos.	2.7
	670	20 min.	4.7
		4 hrs.	4.3
		1 wk.	5.0
		3 mos.	3.7
	680	20 min.	5.0
		4 hrs.	4.9
		1 wk.	5.0
		3 mos.	3.8
Open Hearth steel	600	20 min.	8.2
		40 min.	7.5–7.5
		5 hrs.	7.5
		24 hrs.	7.2–5.9
		1 wk.	7.0
		3 mos.	6.2

There is a remarkable decrease of notch toughness with the increase of aging time after the deformation at 600° C. This is much more pronounced with Thomas steel than with open hearth steel. The aging effects are less pronounced at the higher temperatures of deformation. GN(10f)

The Aging of Steel. ALBERT SAUVEUR. *Fuels & Furnaces*, Vol. 9, Sept. 1931, pages 1019–1024.

In the aging of metals, particularly that of steel, 2 types of aging must be considered: aging after quenching and aging after cold work deformation. Comparing the equilibrium diagrams of duralumin and C-Fe, the author sees the best explanation for the aging phenomenon in the Fe_3C precipitation which results, after quenching, in increased hardness. The specific effects of cold working, i. e., increase of strength, elastic limit and hardness but decreased ductility, are intensified by rest at room temperature; this can, therefore, be considered as aging. And, just as in aging after quenching, the changes due to aging after cold work deformation may be greatly hastened by heating to relatively low temperatures, generally not exceeding 400° C. in the case of Fe-C alloys. This effect can also be ascribed, like that after quenching, to the precipitation of a solute on account of a distortion of the space lattice of the solvent by which it is rendered less capable of retaining the solute in solution. This would mean that an undisturbed lattice can retain, in solution, a greater amount of the solute; a distorted lattice behaves in this respect like a supersaturated solution. But, while in the case of quenching Fe_3C is precipitated, in the case of cold work deformation it is FeO. This theory would also explain the blue heat brittleness phenomenon often observed after cold working. But the author does not think that sufficient evidence of aging caused by precipitation after cold work deformation has been adduced to be fully conclusive. Ha(10f)

On the Age-Hardening Mechanism in Aluminum Copper Alloys. K. HONDA & S. KOKUBO. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 621–633. 15 figures, 20 references.

The age hardening is ascribed primarily to lattice distortion rather than to the presence of $CuAl_2$ particles in colloidal dispersion. On Honda's theory, the process of lattice distortion preponderates up to an aging temperature of 200° C. At 250° C., the distortion has been eliminated and the precipitation process is at its maximum. Coagulation then follows and finally redissolution. The relative magnitude of these processes and the amount to which they overlap is alleged to explain the hardness-temperature curve. HWG(10f)

Malleableizing (10g)

Dilation Bar to Control Anneal of White Iron. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*. Vol. 20, No. 5, Nov. 1931, pages 77–78.

The writer proposes a dilatometric method of control of annealing time in malleableizing. A pilot bar of the same material being annealed is followed in its expansion due to graphitization and will indicate, by no further expansion, the end point of the anneal. WLC(10g)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

Welding in Shipbuilding. A. T. WALL. *Welding Journal*, Vol. 28, Oct. 1931, pages 302–303.

Lecture given before members of the British Acetylene Association and the Institution of Welding Engineers, Sept. 23rd, 1931. The author states that during the past 15 years there has been little progress in welding as applied to shipbuilding. He suggests fear as one of the causes. In order to further use of welding, the author suggests starting a shipyard entirely for welding. It is pointed out that the strongest ordinary riveted joint is about 75% efficient, whereas a 100% joint can be made by the use of welding. Other advantages are saving weight at the joint, continuous longitudinal and transverse strength, better distribution of material, ease of stiffening plates and perfect oil and water tight work. TEJ(11c)

An Improved Product by the Use of Bronze Welding. H. F. REINHARD. *Journal American Welding Society*, Vol. 10, Oct. 1931, pages 5–8.

Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. The author tells about the use of bronze welding as applied to light gage galvanized sheet steel and iron in the fabrication of an acetylene generator, and how the strength, life, gas and water-tightness and resistance to shipping and handling damage were greatly increased by the use of bronze welding. TEJ(11c)

Gas-Welding and Electro-Welding Problems. (Neuzeitliche Gas- und Elektro-Flammverschmelzungs- und Durchbrennverfahren.) F. KRYNES. *Zeitschrift des Oesterreichischen Ingenieur- und Architekten Verein*, Vol. 83, Oct. 2, 1931, pages 300–302.

The author summarizes the various lectures delivered at meetings of the Oesterreichischer Ingenieur- & Architekten Verein referring to problems in the fields of welding. EF(11c)

The Influence of Copper Content on the Fusion Weldability of Mild Effervescent Steel. (Ueber den Einfluss des Kupfergehalts auf die Schmelzschweissbarkeit von unruhig vergossenem weichem Flussstahl.) K. L. ZEYEN & H. MEHL. *Schmelzschweissung*, Vol. 10, Nov. 1931, pages 264–268.

A small addition of Cu is known to increase corrosion resistance, elastic limit and strength in hot working. The present investigation was made to determine whether, and in which manner, the fusion-weldability (with which resistance butt welding, is also included) is influenced by Cu. The conclusion is that low C effervescent mild steel can be butt welded with Cu contents up to 2%. The tensile test showed, in all cases of welded—not heat treated—samples, more than 90% of the tensile strength of the full material. The bending angle in the bending tests decreased considerably in the samples with Cu above 1%. Samples made of bare, not coppered, welding wire by electric arc welding showed in the tensile test values of over 80% of the full material up to 2% Cu. Samples made by gas-fusion welding gave, only for Cu contents below 1% tensile strengths of more than 80% of the full material. The samples with higher Cu contents showed, at the edge of the welded seam, fine deposits which had to be assumed to be metallic or oxidized copper as they were observed only on high coppered steels. 9 references. Ha(11c)

New Series of Tests on Flame-Cut Wind Connections. OTIS E. HOVEY. *Engineering News Record*, Vol. 106, April 30, 1931, pages 729–730.

Recent tests made to ascertain whether flame-cutting structural details for wind connections for building frames is reliable confirmed the assumption that no cracks occurred in any of the flame-cut or flame-cut and planed edges and that the load deflection values and stress distribution were about the same for the different types of specimens. No brittleness developed, proving that flame-cut connections are entirely reliable and satisfactory. Ha(11c)

Autogenous Welding and Metallography. (Die autogene Schweissung und die Metallographie.) A. PORTEVIN. *Schmelzschweissung*, Vol. 10, Nov. 1931, page 262.

The rather complex phenomena of physical and chemical nature of welding and their bearing on changes of the material are discussed. Injurious consequences can always be eliminated or compensated for by counteracting factors which must be physical, chemical or mechanical according to the nature of the injurious factor. Ha(11c)

Electron Metal and Its Welding in the Manufacture of Automobiles. (Elektronmetall und dessen Schweissung im Fahrzeugbau.) H. A. HORN & KARL TEWES. *Automobiltechnische Zeitschrift*, Vol. 34, Nov. 30, 1931, pages 762–765.

The welding of electron alloys, which are alloys of about 98% Mg with small amounts of Al, Zn and Mn, is now possible without difficulty. It is done best with the oxy-acetylene flame which must be adjusted absolutely neutral. The flux is applied as a thin, liquid solution in sufficient amount to prevent inflammation of the electron. It usually contains Li; chlorides should be avoided because they attack electron strongly. As electron warps greatly under the flame, it must be carefully pinned down; the distance of pinning points should be between 20 and 50 mm. The flux must be removed carefully after welding because it promotes corrosion. Examples of pipes, chains, frames, etc. are illustrated. It is important that the parts be uniformly preheated to 300° C. Ha(11c)

Welded Joint Carries Column Load of 380 Tons in Lobby Alteration Job. F. P. MCKIBBEN. *Engineering News Record*, Vol. 107, Sept. 3, 1931, pages 374–376.

A detailed description is given of a third field-welded addition to the du Pont building in Wilmington, Del., of several stories, and lobby alterations. A double truss was inserted to pick up a heavy column load at the second floor by a special welded connection. Welding data are added. Ha(11c)

Strength of Structural Welds. H. M. PRIEST. *Engineering News Record*, Vol. 107, Sept. 17, 1931, pages 436–440.

The report of the 5-yr. research program of the American Bureau of Welding is reproduced in detail. 2500 specimens involving 55 forms of joints were welded by 39 fabricators and tested in 24 laboratories. It is stated that the working stresses accepted at present are justified and that satisfactory uniformity in the strength of welds made commercially by any reputable fabricator can be expected. Testing method, welder performance, safety factors are discussed and general recommendations and suggestions for further research are added. Ha(11c)

Fusion Welding in Iron Structure. (Die autogene Schweissung im Eisenhochbau.) C. F. KEEL. *Die Schmelzschweissung*, Vol. 10, Oct. 1931, pages 237–242.

Investigations have proved that autogenous welding can easily be applied in building high structures; butt welds and lap welds can be made with right hand welding. The designer must take care of the special requirements of welding practice by using proper corner sheets, re-enforcing plates, etc. Fusion welded parts should be properly designed under the coöperation of the mechanical designer and the welding expert. Ha(11c)

The Welding of Chrome-Alloy Sheet Metals. G. VAN DYKE. *Metal Stampings*, Vol. 4, Aug. 1931, pages 643–644.

Allegheny metal, a Cr-Ni-Fe alloy (18% Cr, 8% Ni, 0.15–0.06% C), can be welded by electric, gas or spot processes. Care must be taken that, in welding, neither the analysis nor the structure of the metal be changed. The necessary requirements for the flame of gas or acetylene, fluxes used, the regulation of the arc and the temperatures to be observed are described briefly. Ha(11c)

Electric Welding of a Gas-Storage-Tank. **(Reparatur von Gasbehältern mittels elektrischer Schweissung.)** HOHLBEIN. *Gas und Wasserfach*, Vol. 74, May 9, 1931, pages 432–434.

Outlines the electric welding repair work performed on the tray of a 1500 $m.^3$ gas storage tank. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 266. EF(11c)

Effect of Coating of Welding Electrodes upon the Strength of Welds. **(Einfluss von Umwicklung der Schweissstäbe auf die Festigkeit der Schweiss.)** F. RAPATZ. *Stahl und Eisen*, Vol. 51, July 9, 1931, pages 888–889.

Abstract of a paper by K. Baumgärtel in Forschungsarbeiten auf dem Gebeite des Ingenieure Wesens, Publication 336, 1930, pages 1–33. The results of welding tests with coated and uncoated electrodes are summarized. GN(11c)

Large Welded Everdur Pressure Vessels. MARSELIS POWELL & I. T. HOOK. *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 39–47.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Photomicrographs show Everdur weld structures produced under various conditions of hammering and annealing. Best annealing temperature was found to be 650° C. Results of a number of tensile tests of welds are given. The authors then describe the fabrication and testing of 3 large arc welded Everdur pressure vessels, one 500 gal. and two 10,000 gal., designed for a working pressure of 100 $lbs./in.^2$ Longitudinal and girth seams were welded with $^5/_{32}$" Everdur electrode using reversed polarity at 190 amperes. These were butt welds, single 90° V for $^1/_4$" plate and double V for $^1/_2$". Cold working of weld metal was done with air hammers and annealing with gas torches. Hydraulic tests were made at twice the working pressure. TEJ(11c)

Copper Welding Solves Refinery Problem. DONALD R. PRATT. *Journal American Welding Society*, Vol. 10, Aug. 1931, pages 12–13.

A problem in corrosion of refinery still heads and piping, due to the action of hot zinc chloride, was solved by welding in a lining of Cu by means of the oxy-acetylene process. TEJ(11c)

Steel Foundry Welding. V. GORDON PIERSON. *Edgar Allen News*, Vol. 10, Sept. 1931, pages 952–955.

Includes discussion. Particular reference is made to welds on boilers, discovery of defects and tests, requirements in material. Micrographs illustrate the points in question. Ha(11c)

The Development of Electric Arc Welding in Japan. TAKESI OKAMOTO. *Journal American Welding Society*, Vol. 10, July 1931, pages 33–37.

Condensed from a paper presented by the author before the World Engineering Congress in Tokyo, Oct. 1929. A review of the progress made in electric arc welding in Japan during and after the war, both in research and welding applications. Use of arc welding has been greatly extended in shipbuilding, construction of penstocks, pipe, storage tanks, constructional and repair work in railway shops, foundries, and machine shops, as well as in the erection of steel structures. Electrode coatings were investigated, and electrodes developed for arc welding, cast Fe brass, gunmetal, Al alloys and mild steel. Arc welds made in H were found to be superior in regard to density, tensile strength, ductility and forging qualities. The author also includes a review of his recently published paper, "Theoretical and Experimental Research on Electric Resistance Welding," Memoirs of the College of Engineering of Kyoto Imperial University, Vol. 6, No. 1. TEJ(11c)

Resistance Welding of Metal Fabric. W. T. OBER. *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 50–52.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. A description of automatic machinery used for resistance welding of steel fabric such as concrete road reinforcement. TEJ(11c)

Steel Foundry Welding. V. GORDON PEARSON. *Edgar Allen News*, Vol. 10, Aug. 1931, pages 926–930.

A general discussion of conditions in a foundry. The inspection staff should be especially trained in judging, testing and applying welding for repairs, maintenance work, etc. The importance of employing responsible welders and of selecting the proper methods is stressed. Ha(11c)

Large Diameter Pipe Arc Welded for Water Distribution. VINCENT P. MARRAN. *Journal American Welding Society*, Vol. 10, Aug. 1931, pages 5–9.

A description of a process of fabricating large diameter pipe by means of automatic metal arc welding. The author discusses selection of raw material, preparation of the edges for welding, forming and assembling, the welding process, cleaning the surface and coating the pipe. Tests of welds and welded vessels are described. Photographs of equipment used are included. TEJ(11c)

Hydrogen-Welding Now Automatically Controllable. S. MARTIN, JR. (General Electric Co.). *Electrical World*, Vol. 98, Sept. 26, 1931, page 561.

Welding automatically with the atomic H flame requires the maintenance of a definite size flame in a fixed plane between 2 slowly consuming tungsten electrodes. The relation of the fringe of the flame and the work is fixed mechanically. The control system is illustrated. When the start button is pushed, the coil of the line contactor and the coil of the H solenoid valve are energized. These apply power to the electrodes through the reactor and turn on the H gas, respectively. WHB(11c)

Welding Corrosion-Resistant Steels. W. D. MACLEOD. *American Machinist*, Vol. 74, Mar. 19, 1931, page 472.

Discussion of an article of the same title by E. J. Tangerman in American Machinist, Vol. 73, Sept. 18, 1930, page 485. This article states that Ni-Cr-Fe alloys containing 17–25% Cr and 7–12% Ni require no heat treatment for welding. It is true that they do not become brittle due to air hardening but they are subject to weld decay. To prevent this, the whole welded article must be heated to 1050–1100° C. and cooled rapidly. RHP(11c)

Welded Pipe and Fittings in Heating Installations. FRED J. MAEUER. *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 5-13.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Welding of pipe in heating installations is now accepted by architects, building owners, heating contractors, plumbers and steam-fitters as standard practice. Approximately 175 vocational training schools in the United States are teaching pipe welding. Advantages of welded pipe installations are given. Includes 18 sketches and illustrations. TEJ(11c)

Welding Monel Metal for the Construction of Chemical Apparatus. **(Ueber das Schweissen von Monel-Metall im chemischen Apparatebau.)** RUD. MÜLLER. *Die Chemische Fabrik*, Vol. 4, July 1931, pages 310–312.

Contains 2 references. Monel metal has great affinity for O when molten, forming CuO. With proper care, it can be electric arc welded with coated Monel metal wire. The coating consists of Mg-Mn-Si or Ti-Ca alloy. The work should be negative and held together with clamps to prevent warping. The edges should be champfered. Monel metal can also be welded by the atomic H, electric resistance, spot, hammer and gas processes. When gas welding, a neutral or slightly reducing flame should be used. Cleanliness of the joint is essential. An aqueous solution of equal parts of boric acid and borax is sometimes used as flux, but a flux is not necessary. 100% tensile strength, good ductility and corrosion resistance are obtained in the joint. CEM(11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Contribution to the Explanation of Metallic Volatilization Processes (Beitrag zur Deutung der Metallverflüchtigungsprozesse). Ilja Westermann. *Metall und Erz*, Vol. 28, May 1931, pages 214–217.
2 references. When Pb is melted in a cupel and heated, PbO is formed and part of it is absorbed by the cupel, part of it volatilizes. The temperature of the lead increases over that of surrounding matter. As the volume diminishes the proportion of exposed surface to surface touching the cupel increases and the heat is not conducted away as rapidly. To prove this a test was made in a specially constructed muffle using a thermocouple to measure the furnace temperature and an optical pyrometer through a window in the top for the temperature of the lead. The proportions of PbO volatilized and absorbed were found by determining PbO in the cupels after the tests. It was found that the proportion volatilized decreased with increase in size of sample. With 10 gm. sample 74% volatilized, with .1 gm. 1%. When bronze is melted in a converter without coke a very small part of the tin volatilizes and part of it remains as copper stannate. This is explained by the small surface of tin exposed. When bronze is heated with coke most of the tin volatilizes according to the following steps: Sn is oxidized to SnO_2 by O_2 in the air, SnO_2 is reduced by the solid C to Sn in small particles, the small Sn particles are oxidized to SnO_2 by O_2 and volatilized, and the small SnO_2 particles are removed by the stream of gas. CEM(12a)

Two-Cycle Anneal for Malleable Iron. Correspondence from T. Kikuta, Sendai, Japan. *Metal Progress*, Vol. 20, Oct. 1931, pages 86–88.
The writer reports the results of experiments in electric melting supplemented with a cupola for the production of white cast iron. A 2-cycle anneal without packing material is described for the complete graphitization of white iron. WLC(12a)

Steel Quality as a Matter of Furnace Control. *Iron Age*, Vol. 127, June 11, 1931, pages 1902–1904.
From a report of the Open Hearth Committee of the American Institute of Mining and Metallurgical Engineers, May 21–28, 1931. Deals particularly with inclusions and segregation. Control of the amount of Fe_2O_3 going into the slag is controlled by melting in an atmosphere which is slightly oxidizing, according to Prof. Trinks. Otherwise, there is an excess of O in the early part of the flame and over oxidation of the steel results. Experiments show a little more N in killed steel than in rimmed steel. VSP(12a)

Obtaining Clean Steel from the Acid Open-Hearth. C. H. Herty, Jr. & J. E. Jacobs. *Rolling Mill Journal*, Vol. 5, Feb. 1931, page 106.
Abstract of a paper presented at the Western Metal Congress, week of Feb. 16. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 224. JN(12a)

An Application of the Triangular Co-ordinate System for the Graphic Determination of the Burden for Remelting Furnaces (Eine Anwendung des Dreieckskoordinatensystems auf die graphischen Gattierungsberechnungen für Umschmelzöfen). P. Schmidthuysen. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Oct. 9, 1931, pages 800–803.
The author develops a new means of calculating the burden on the basis of 3 single elements, which determines in a simple graphical manner the amount of the individual materials to be melted together. The method is illustrated and explained by means of several examples. Ha(12a)

Iron as Fuel in Open Hearth Refining Processes (Das Eisen als Heizstoff bei den Frischverfahren von offenen Herdflammofen). F. Wüst. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, Mining & Metallurgy, Part 1, pages 463–479.
One hundred and thirty to 200 lbs. of iron are burnt by the furnace gases per ton of steel made. Tables of oxygen balances are given. HWG(12a)

Debismuthising Lead with Calcium. *Metal Industry*, London, Vol. 38, May 15, 1931, pages 503–504.
Abstract of a paper read before Electrochemical Society, Birmingham, Ala., Apr. 23–25, 1931. If Ca is added to Pb at 482° C., a dross is formed removing Bi and scavenging the last traces of As, Sb, Ag, Cu, but not Sn. Some Ca remains to harden the Pb unless removed by blowing with steam or Cl. The most economical use is with lead having 0.5% Bi. See *Metals & Alloys*, Vol. 2, May 1931, page 105. PRK(12a)

Practice in Making Duplex Steel. J. E. Carlin. *Transactions American Society for Steel Treating*, Vol. 17, May 1930, pages 631–637.
See *Metals & Alloys*, Vol. 1, Oct. 1930, page 802. (12a)

Production of High Grade Steels in High-Frequency Furnaces (Erzeugung von Edelstählen in Hochfrequenzöfen). *Elektrotechnische Zeitschrift*, Vol. 52, July 2, 1931, pages 875–877; *Metallurgist*, Nov. 1930, pages 166–167.
Extended abstract of "Die Erzeugung von Edelstählen im kernlosen Induktionsofen" by O. Dörrenberg & N. Broglio, Report No. 183 of the Steel Works Committee of the Verein deutscher Eisenhüttenleute published in *Stahl und Eisen*, Vol. 50, May 8, 1930, page 617. See *Metals & Alloys*, Vol. 1, Sept. 1930, page 736. Ha+VVK(12a)

Institute of Metals (London Section). *Metal Industry*, London, Vol. 38, Apr. 24, 1931, pages 429–431; May 1, 1931, page 452.
An open discussion on the remelting of metals and the use of scrap. PRK(12a)

Melting Steel in a Brackelsberg Furnace. P. Bardenheuer. *Heat Treating & Forging*, Vol. 17, Feb. 1931, pages 177–179.
See *Metals & Alloys*, Vol. 2, Feb. 1931, page 42. Ha(12a)

Production and Heat Treatment of Alloy Steels. R. A. Bull (Electric Steel Founders Research Group). *Metals & Alloys*, Vol. 2, Sept. 1931, pages 101–105.
The utility of the electric furnace for the production of small heats of special steels has made possible development of such material. The author comments on the impressiv properties obtainable by proper heat treatment of common steel castings. Development of composition, heat treatment and specification for alloy steel casting is discussed. The question of design of castings to avoid shrinkage troubles and oth r points to guard against in production of alloy castings are discussed. WLC(12a)

Casting & Solidification (12b)

Some Notes on Teeming Speeds of Ingots. A. Jackson. *Iron & Coal Trades Review*, Vol. 122, Feb. 13, 1931, pages 277–278.
The following results can be summarized from tests to find the relation of pouring speed of ingots with varying types of nozzles and the relation of the speed to the quality of ingots produced: a suitable pouring speed for the production of sound ingots seems to be 120 secs. with an absolute minimum of 100 secs. For this reason, other than fireclay pots should be used because about the first 20 or 25 tons out of 80 are above this speed. The only choice at present seems to be the magnesite-ring type of pot. If an ideal pot giving a straight horizontal line teeming rate could be made, teeming time could be saved. A fireclay nozzle with a magnesite ring has a fairly good life. See also *Metals & Alloys*, Vol. 2, July 1931, page 135. Ha(12b)

What Size Should the Steel Ingot Be? Joseph Miller. *Iron Age*, Vol. 128, Aug. 6, 1931, pages 364–365.
Determination of sizes into which ingots are to be cast is first consideration in steel mill practice. Ability to cut the ingot product to proper size avoiding shorts, is one of the problems. Determination of top and bottom crops depends upon the specifications and quality desired in rolled product. It is customary to cast high C and other high metalloid steels in ingots of moderate size, and rectangular instead of square, to hasten solidification and to arrest segregation of C, P and S. Large ingots are likely to crack due to unequal cooling strains. Considers also factors influencing ingot design. VSP(12b)

Flexibility of Continuous Molding. (Unité de moulage continu.) J. Mort. *Revue Fonderie Moderne*, Vol. 25, Aug. 25, 1931, pages 301–303.
The author sees the greatest disadvantage of continuous molding and casting installations in their lack of flexibility to adapt them to changing conditions. He emphasizes the fact that they should be installed only where conditions can be considered as stable for some time to come. An installation is described where pieces of 2000 × 1200 × 250 mm. can be placed on the conveyor which is able to carry 16 tons total weight. This unit is operated by 7 men. The daily production in 8 hrs. averages 100 sections of radiators and similar pieces of 85–150 kg. each. The space taken by the installation is 35 m. long, 25.856 m. wide and 11.86 m. high. HA(12b)

The Flotation of Graphite in Cast-Iron. A. L. Norbury & C. Rowley, *Bulletin British Cast Iron Research Association*, Vol. 3, July 1931, No. 1, pages 7–9.
Analyses of the total C content of gray pig iron at various points from the top to the bottom of the face of the fractured pig show that the graphite floats upward as the pig solidifies. Several specimens had 0.27% more C in the top part than at the bottom where the amount of C was about 3.5%. The tests also support the modern view that the graphite is deposited directly from the melt and is not a decomposition product of solidified white iron. The method of sampling and testing is described. Ha(12b)

Wall-Thickness Sensitive Cast Iron. (Ueber wandstärkenempfindliches Gusseisen.) R. Mitsche. *Giesserei mit Giesserei-Zeitung*, Vol. 18, July 3, 1931, pages 537–539.
The wall-thickness sensitivity is defined by the author as the property of a cast iron alloy of assuming, at different cooling velocities, more or less pronounced differences in the formation of the structure and, consequently, in the tensile properties. The greater the differences at a certain change of the cooling velocity are, the more wall-thickness-sensitive the alloy is. The influences which determine this sensitivity have not yet been fully elucidated. They are discussed and a qualitative test is suggested for their determination. This test consists of casting a small sample of such dimensions that the cooling velocities in the different parts of the sample do not differ too much. This sample is examined microscopically. An example is given and 5 references are cited. Ha(12b)

The Casting of Best Ingots from the Point of View of Forging (La coulée des meilleurs lingots en vue du forgeage). H. H. Ashdown. *Revue Fonderie Moderne*, Vol. 25, Sept. 10, 1931, pages 335–336.
See "Steel Ingots," *Metals & Alloys*, Vol. 2, July 1931, page 135. Ha(12b)

The Ingot Phase in the Manufacture of Rolled Steel Products. Part VIII. John H. Hruska. *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 129–130.
A pronounced fibrous structure is undesirable in most steels. This structure may be produced experimentally by adding powdered slag of acid character to steel. The fibers invariably cover the entire cross-section of the fracture. Woody structures, however, are usually found only near the middle of the fracture. These portions contain higher proportions of basic constituents. Slaty steels show well pronounced layers of a smoother ferrous material which are high in C, P, and S content. JN(12b)

Permanent Molds for Zinc Alloy Castings. Edw. Heller. *Machinery*, Vol. 37, July 1931, pages 829–831.
2 examples for quantity production are described. The molds are heated to 500–550° F. before casting. Ha(12b)

Solidification and Crystallization of Steel Ingots; Influence of Casting Temperature and the Undercooling Capacity of the Steel. B. Matuschka. *Iron and Coal Trades Review*, Vol. 123, Oct. 2, 1931, pages 485–487.
The solidification and crystallization of steel ingots are absolutely regular phenomena. The external conditions which initiate them and cause them to continue are determined by the cooling of the mold. The internal solidification conditions determine the solidification and crystallization in the ingot under given conditions of heat dissipation by the mold. They are principally influenced by the casting temperature and the under-cooling capacity of the steel. The paramount importance of one of the factors is determined by the composition and the physical and crystallographic properties of the steel. In all cases, a low casting temperature and maximum purity make for finer primary crystallization and less segregation, which means improved quality because of increased uniformity. X-ray photographs illustrate the freezing of a 350 kg. ingot. Ha(12b)

A Contribution to the Study of the Fluidity of Metals. (Beitrag zum Studium der Dünnflüssigkeit der Metalle.) U. Gabino. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, page 868.
The fluidity of a metal is defined as that property of filling a mold more or less completely. The relation between fluidity and temperature depends on the chemical composition of the steel (as for all metals) and on the chemical reactions at high temperatures between the metal and the materials of the mold. The different influences are discussed and the best pouring conditions are determined. It is better to dry the molds before pouring. Ha(12b)

The Calculation of the Processes of Cooling and Freezing of Liquid Metal. II. (Die rechnerische Behandlung der Abkühlungs- und Erstarrungsvorgänge bei flüssigem Metall. II.) C. Schwarz. *Archiv für Eisenhüttenwesen*, Vol. 5, Oct. 1931, pages 177–191.
Report 217 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The paper continues the first part of the investigation by giving some more exact calculation methods on the freezing conditions of steel ingots. The calculations take particularly into account the split which is present between steel and mold wall when the molds are coated or which appears as soon as the steel in the mold starts freezing. A comparative calculation of the cooling conditions of an ingot poured under normal conditions of production and of an ingot pressed according to the Harmet method shows the differences as to velocity of freezing and distribution of temperature in mold and ingot. The results of actual tests are plotted in diagrams which clearly indicate the above relations. The paper finally points out that it will be necessary to introduce the velocity of freezing in studying processes of crystallizatiion. Number of nuclei and velocity of crystallization are not sufficient to get a proper insight into crystallization. GN(12b)

Blow Holes in Aluminum Sand Castings. II. The Appearance on Metals Previously Exposed to Corroding Influences. (Undichtigkeiten in Aluminium Sandguss. II. Teil. Die Erscheindungen an Metall, das vorher korrodierenden Wirkungen ausgesetzt war.) G. Hanson & I. G. Slater. *Korrosion und Metallschutz*, Vol. 7, Oct. 1931, page 250.
Reference is made to a lecture at the 24th General Meeting of the Institute of Metals, Zurich, September 1931. EF(12b)

Reciprocal Action between Steel Ingot and Mold. (**Action réciproque entre lingot d'acier et lingotiére.**) A. McCance. *Revue Fonderie Moderne*, Vol. 25, Aug. 25, 1931, pages 317–318.

The article explains the phenomena of mutual heating and cooling effects when a cast iron mold is filled with hot metal; the condition of the external skin of the ingot as dependent on the thickness; and dimensions of the mold. Three zones of this external layer are distinguished: the first, of about 3 mm. thickness of very fine crystals, is formed during the first few seconds of pouring; the second zone is formed while the heat exchange drops from 15 to 4 cal./sec.; and the third zone, below 4 cal./sec. See also "Ingots & Ingot Moulds," *Metals & Alloys*, Vol. 1, June 1931, page 114. Ha(12b)

Rolling (12c)

The Rolling Time of Merchant Mills. U. A. Peters. *Rolling Mill Journal*, Vol. 5, Mar. 1931, pages 187–189.

The author makes a time study comparison of 7 different arrangements of merchant mills of various types and tabulates the time and distance data for each pass. Each layout consists of 4 passes and the corresponding passes yield the same amounts of reduction. The method is extended to a detailed time study and analysis of a cross-country merchant mill layout of 10 passes. JN(12c)

The Rolling of Alloys of Copper and Phosphorus. Owen W. Ellis. *Rolling Mill Journal*, Vol. 5, Mar. 1931, page 218.

Abstract of a paper presented before the Institute of Metals at London, Mar. 11, 1931. See *Metals & Alloys*, Vol. 2, July 1931, page 135. JN(12c)

The Effect of the Lateral Pressure on the Deformation during Rolling and the Quality of Material. (**Der Einfluss des Seitendrucks auf die Formänderung beim Walzen und die Güte des Werkstoffs.**) *Stahl und Eisen*, Vol. 51, Mar. 5, 1931, pages 295–300.

Discussion between H. Hilterhaus & W. Tafel on the above paper by Hilterhaus, published in *Stahl und Eisen*, Vol. 50, 1930, pages 1185–1197, 1221–1229. GN(12c)

British Cold-Rolling Strip Mills. C. E. Davies. *Blast Furnace & Steel Plant*, Vol. 18, Dec. 1930, pages 1801–1802, 1806.

Discussion of English practice where especially high rolling speeds and heavier reduction/pass have been adopted with simultaneous increase in rigidity and strength of roll frame and housing design. Ha(12c)

Comparison of Methods Used for Electrically Preheating Sheet Mill Rolls. A. J. Whitcomb. *Freyn Design*, No. 9, Oct. 1931, pages 15–18.

The relative advantages of various methods of preheating rolls by resistance and induction methods are discussed and the practical arrangements are described. Ha(12c)

Forging (12d)

Weldless Forged Steel Pressure Vessels. John L. Cox. *Chemical & Metallurgical Engineering*, Vol. 37, Sept. 1930, pages 585–586.

Outlines procedure followed in the construction of weldless vessels. In C steel, it is possible to produce forged weldless cylinders up to 6 ft. internal diameter and of the maximum weight that can be obtained from a 225-ton ingot. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 271. MS(12d)

Press Working and Forming of Metals. Pt. XXX–XXXI. *Metal Stampings*, Vol. 3, Nov. 1930, pages 999–1002, 1008; Dec. 1930, pages 1107–1110.

These parts deal with hot press forging. Summarizes types of forging equipment. Defines hot working with reference to the state of the metal Discusses effects of speed of operation on resistance to movement, generation of heat and chilling of heated blanks, and press forging of steel, Cu, brass, Al, duralumin, Zn, Pb and Sn. MS(12d)

Pressure-Forging Gear Teeth. J. R. Cornelius. *American Machinist*, Vol. 75, Aug. 27, 1931, page 335.

Nickel-steel blanks are upset to fill out a die and are then accurately finished in a rolling machine. Ha(12d)

Taking Engine Indicator Cards of Hammers and Forging Presses. (**Das Indizieren von Hämmern und Schmiedepressen.**) W. Kalkhof. *Stahl und Eisen*, Vol. 51, Aug. 6, 1931, pages 995–1001.

Report 87 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. The article summarizes the results of time and energy consumption studies of hammers and forge presses. GN(12d)

Extruding (12f)

Extruding Metals in Solid and Hollow-Plunger Presses. O. Busse & C. Busse. *Engineering Progress*, Vol. 12, Aug. 1931, pages 177–180.

After a brief historical development of the manufacture of bars, shapes and wires of brass and similar alloys by extruding, the various methods and machines are fully described. Ha(12f)

High-Efficiency Hydraulic Extrusion Presses for Non-Ferrous Metals. *Brass World*, Vol. 27, June 1931, pages 135–137.

Advanced ideas in extrusion of Cu and Al alloys are embodied in the new types of equipment for forming a variety of shapes of complex, as well as of simple design. WHB(12f)

Bobbin Quills by an Unusual Method. *American Machinist*, Vol. 75, Aug. 6, 1931, page 229.

Description of the extruding process from blank to finished quill. Ha(12f)

Coloring (12m)

Black Coloring of Iron and Steel. (**Schwarzfärben von Eisen und Stahl.**) K. Schuch. *Oberflächentechnik*, Vol. 8, Sept. 1, 1931, pages 186–187.

A description of several methods. Conversion of the surface, first, in iron oxide, then, in magnetic oxide of iron at high temperature. Recipes for black oxidizing are given, as well as for a black arsenic deposit on iron. Ha(12m)

Brown Colorings on Brass and Copper. (**Braunfärbungen auf Messing und Kupfer.**) K. Schuch. *Oberflächentechnik*, Vol. 18, Aug. 18, 1931, pages 176–177.

Several recipes are given for liquids or pastes which give pleasing brown to brownish-green surfaces in art metal work. Ha(12m)

Spinning (12p)

How to Spin a Copper Tea Urn. William Mason. *Metal Industry*, N. Y., Vol. 29, May 1931, pages 199–200.

A detailed description of the operation involved in spinning a tea urn out of 0.040 in. copper. PRK(12p)

DEFECTS (13)

Remarkable Effect of a Pipe in an Angle Shape. (**Bemerkenswerte Wirkung eines Lunkers in einem Winkeleisen.**) F. Rötscher. *Stahl und Eisen*, Vol. 51, Apr. 23, 1931, page 521.

The widening of a pipe in the angle shape which was investigated was found to be due to the evaporation of water which had penetrated into the pipe. GN(13)

An Investigation of Steels for Aircraft Engine Valve Springs. A. Swan, H. Sutton & W. D. Douglas. *Engineer*, Vol. 151, Feb. 27, 1931, pages 231–232; *Engineering*, Vol. 131, Feb. 27, 1931, pages 314–316; Mar. 13, 1931, pages 374–376.

Condensed from paper read before the Institution of Mechanical Engineers, Feb. 20, 1931. See also discussion in Engineering, Vol. 131, Feb. 27, 1931, pages 307–308. LFM(13)

Criticism of Crankshaft Fractures. (**Beurteilung von Kurbelwellenbrüchen.**) E. A. Wedemeyer. *Automobiltechnische Zeitschrift*, Vol. 34, July 20, 1931, pages 472–475.

A series of fractured crankshafts is discussed with regard to the kind of fracture (bending fracture or torsion fracture) and the causes for them explained. They are: notch effect due to sharp corners, additional bending moments due to wear of bearings, warping of the shaft due to defective alignment, defective design (outside flywheel), defective materials. Fracture due to torsional vibrations is particularly discussed. Ha(13)

Note on the Failure of a High-Strength Brass. J. E. Newson & A Wragg (Vickers-Armstrong, Ltd.). *Institute of Metals, Advance Copy* No. 578, Sept. 1931, 9 pages.

The rapid failure of a brass rod containing 58.5% Cu, 1% Fe, 3.0% Al, 1.5% Mn, and 34.0% Zn was observed. The rod had been extruded and straightened in a two-roll reeling machine. Cracks were observed in rods that had merely been stored for several months. A study indicated that the reeling (straightening) operation had introduced tensile stresses in the interior of the rods, which caused the formation of internal cracks. A low temperature anneal removed all possibility of residual stress cracking. A similar defect could not be produced in some brasses that did not contain Al, but these latter brasses had an α plus β structure, while the Al-brass consisted entirely of β. Contains 9 references. JLG(13)

Interesting Points Developed Through Investigation of the Seams of Wood Pulp Digesters. J. P. Morrison. *Locomotive*, Vol. 38, July 1931, pages 198–205.

After a disastrous pulp digester explosion, a thorough investigation was made and the tests made to discover the causes are described in this article. The conclusions are: (1) it is found imperative to use a material of fire box quality; (2) the single strap butt-joint as well as the lap seam joint are not dependable when used in the construction of plate 1 in. and upward in thickness; in such cases, the seam should be of double butt-strap riveted construction or welded. Grooves resulting from corrosion should be most carefully watched because they weaken the material seriously. Tell-tale holes are necessary to decrease the hazard of digester operation. Ha(13)

Defects in Large Forgings. G. A. Smart. *Heat Treating & Forging* Vol. 17, Aug. 1931, pages 759–762.

The causes of piping and gas pockets, cracks in ingots, red shortness and its effects, ghost lines are explained and illustrated by photographs. The importance of eliminating these troubles is emphasized. Ha(13)

Nature of Abnormal Grain Growth in High Speed Steel. G. R. Brophy & R. H. Harrington (General Electric Co.). *American Society for Steel Treating, Preprint* No. 12, 1931, 15 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The so-called fish-scale or marble fracture in high speed steel is due to abnormal grain growth resulting from strains in the material prior to hardening. The authors present a study of the effect of strains produced thermally. The influence of small composition differences within the specimen on the heat treatment of high speed steel is discussed. WLC(13)

Causes and Avoidance of Tool Steel Failures. W. H. Wills (Ludlum Steel Co.). *Metals & Alloys*, Vol. 2, Sept. 1931, pages 112–116.

The facilities and interests of 3 groups, steel makers, tool makers and tool users, are discussed. Increasing applications for tools and their materials and demand for higher quality steel are the problems of the steel maker. Careful control by the tool maker of his conditions of heat treatment enable him to reduce his defective tools. Causes of failure due to the steel mill and due to the heat treatment are discussed. Importance of drawing is stressed. Tests such as deep etch and hardenability tests are discussed. WLC(13)

CHEMICAL ANALYSIS (14)

The Estimation of Silicon in Copper-Silicon Alloys. W. F. Pond. *Chemist-Analyst*, Vol. 20, Sept. 1931, pages 7–8.

Sawings freed from Fe by a magnet are used as a sample. 2 gm. are dissolved in 25 ml. concentrated HNO_3, 1 ml. concentrated HCl and 2 ml. concentrated H_2SO_4 added, evaporated to dryness and baked $1^1/_2$ hours. 30 ml. H_2O and 25 ml. concentrated HNO_3 are added, the solution boiled and filtered through No. 42 Whatman paper and washed with hot H_2O and hot 5% HNO_3. The precipitate is ignited slowly in platinum crucible and weighed as SiO_2. Addition of HCl reduces the volume of the siliceous mass and prevents bumping. CEM(14)

Determination of Magnetite in Copper Slags. Lathrop E. Roberts & R. L. Nugent. *United States Bureau of Mines Report of Investigations* 3120, Sept. 1931, 14 pages.

The following modifications of the Hawley method for determining magnetite in copper slags are proposed: (1) boil the sample 1 min. with the oxidizing mixture, instead of merely bringing to a boil; (2) catch the residue from the oxidation in a Caldwell crucible on an asbestos filter instead of paper; (3) dissolve the residue in Pt in a CO_2 atmosphere, rather than in glass in air; (4) titrate with titanous chloride in the cold, instead of with $SnCl_2$ in boiling solution. Magnetite can be determined with an accuracy of 2%. AHE(14)

Electrolytic Determination of Lead as Lead Dioxide. W. T. Schrenk & Philip H. Delano. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 27–29.

Best results by this method were obtained under the following conditions: time $1^1/_2$ to 2 hours, current 3 amperes, temperature 90° C. Anodes should be sand blasted and clean and the amount of Pb present between 5 and 150 mg. Solution should contain from 20 to 30% free nitric acid and about $^1/_4$ cc. sulphuric acid. Interfering elements should be absent. Effects of interfering elements were investigated and the precision of the method was determined. MEH(14)

Wavelength Tables for Spectrum Analysis. Compiled by F. Twyman & D. M. Smith. Published by Adam Hilger, Ltd., London, 1931, Second Edition. Cloth, 5½ × 8½ inches, 180 pages. Price 14s. 6d.

Various useful tables for use in chemical and metallurgical spectrography have been published since the first edition of this book was compiled, and the present time is opportune for the appearance of an up to date laboratory handbook containing all the necessary data for use in analysis by flame, arc and spark methods.

The most recent interferometric measurements of standard wavelengths have been included, and the tables of persistent lines have been revised to the I.A. scale. Tables of such lines for arc spectra (by J. W. Ryde and H. G. Jenkins), and flame spectra (by Prof. Lundegardh) are now reproduced with explanatory notes.

For those wishing to study the subject more fully from the standpoint of modern physics the section on "The Various Types of Spectrum" (by Prof. Andrade) and the complete table of ultimate lines by Dr. A. T. Williams (to which have been added spectroscopic information such as excitation potentials and temperature classification) will be of interest.

The Appendix deals with the phenomena of the condensed spark discharge and the precautions necessary for its standardization for quantitative analysis.—(14)-B-

Die Sampling Cyanide Gold Bullion at the Sons of Gwalia Gold Mine, Gwalia, Western Australia. Charles O. A. Thomas. *Australasian Institute of Mining and Metallurgy* No. 81, Mar. 30, 1931, pages 17–22.

Comparison of dip samples from the molten bullion and boring samples from 32 ingots show that in the majority of cases the borings assay higher in Au. AHE(14)

Special Problems in the Spectral Analysis of Metals. (**Specialprobleme der Spektralanalyse von Metallen.**) G. Scheibe. *Metallwirtschaft*, Vol. 10, Sept. 11, 1931, pages 723–724.

5 references. By means of spectral analysis, impurities of 0.001% or less can be determined more accurately and quickly with the use of smaller samples than by chemical means. The spectrum is produced by using 2 samples of the metal as electrodes and passing an electric arc across them or a spark of definite capacity from a condenser. For very quick results the visual method with a simple photometer and a spectroscope can be used, such as for the determination of alloys in steel. It is preferable to photograph the spectrum which takes about 30 mins. altogether. The accuracy of this method is about 2% of the element being determined. Si, B, Cr, Ni, Mo, W and V can be determined in steel, Pb in Sn and Cd, and Sb, Sn, Cd, Bi, Cu, Fe and Ni in Pb. The apparatus is the same for all elements except the spectrograph. For most determinations the ultra-violet part of the spectrum is used. CEM(14)

The Influence of Cobalt upon the Determination of Manganese by the Bismuthate Method. Takayuki Somiya. *Journal Society of Chemical Industry*, Japan, Vol. 33, July 1930, page 255B.

The author studied whether or not Mn could be determined by using the method where Mn is oxidized at room temperature by sodium bismuthate in the solution containing 20–40% (by volume) of nitric acid, if ice-cooled solution were used and the concentration of nitric acid were reduced to 1:11, 1:15, or 1:19. He found that Co was oxidized by sodium bismuthate at all temperatures and at all concentrations of nitric acid. The amounts of Co and Fe in the solution, the temperature of oxidation, the concentration of nitric acid, or the time of agitation affected the results, namely when any of these factors slightly varied, the amount of Mn found by titration was also different and the true amount could hardly be determined. MAB(14)

Contributions to Metallurgical Chemistry. (**Beträge zur Eisenhüttenchemie.**) A. Stadeler. *Stahl und Eisen*, Vol. 51, July 9, 1931, pages 889–891.

The article summarizes 11 recent publications (Jan.-Mar. 1931) on the apparatus and analysis of pig iron, steel, iron, slags, refractories, fuels, gases, oils, etc. GN(19)

Separation of Manganese from Cobalt by Ammonium Persulfate. Takayuki Somiya. *Journal Society of Chemical Industry*, Japan, Vol. 33, July 1930, pages 255B–256B.

The complete separation of Mn from Co is very important. The amount of Co that was carried down with the Mn oxides precipitated and the amount left in the filter was investigated. It was found that: (1) manganese oxides free from Co could not be precipitated with ammonium persulphate in ammoniacal or neutral solution. There was no difference in the procedures. (2) In ammoniacal solution containing considerable amounts of Zn and Co, it was difficult to precipitate Mn oxides in coarse enough form to be filtered off, and hence Mn was likely to be lost in the precipitate. It was possible to precipitate Mn completely provided the precipitation was repeated by adding ammonium persulphate and boiling until no precipitate was formed. (3) When the precipitation took place in a solution containing considerable Zn, the manganese oxides contained a very small amount of Co and could be filtered off easily. Mn might remain in the filtrate because the solution became acid due to the decomposition of ammonium persulphate. (4) In a neutral solution, the amount of Mn left in the filtrate and that of the Co carried down with the manganese oxides were much reduced by the presence of the zinc ion. MAB(14)

Determining Molybdenum in Steel. H. C. Weirick & C. H. McCollam. *Heat Treating & Forging*, Vol. 16, Sept. 1930, pages 1145–1146, 1155.

Describes in detail a method of determination of Mo in steel and iron which depends on the solubility of molybdic acid in sodium hydroxide. By means of this solubility, it is separated from the iron and is precipitated as lead molybdate from an acetic solution with lead acetate. Ha(14)

The Emission Spectrum Analysis in the Steel Industry. (**Die Emissions-Spektralanalyse in der Eisenindustrie.**) G. Scheibe. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 579–586; *Stahl und Eisen*, Vol. 51, June 18, 1931, page 775.

The paper deals with the application of small spectrometers for the qualitative analysis of Fe alloys. Within certain limits, quantitative determinations can also be made. A special method to determine Si in steel is described. An intensity method was developed for exact determinations and results of this method are given in determining Si and B. GN(14)

Investigation of Ammonium Acetate Separation of Sulfates of Lead, Barium and Calcium. Wilfred W. Scott & Samuel M. Alldredge. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931 pages 32–33.

7 references. It was found that in the ammonium acetate treatment of the sulphate precipitate, Pb may be separated from Ba, but not entirely from Ca; also that as the amount of Ba increases there seems to be an increasing difficulty in extracting all the Pb, and that less Ca is extracted in the presence of Pb and Ba than when it is the only constituent of the sulphate precipitate. MEH(14)

Fire and Chemical Analysis. Nathaniel Herz. *Engineering & Mining Journal*, Vol. 132, Oct. 12, 1931, pages 308–309.

One of the papers of a symposium on "The Homestake Enterprise." Free CN is estimated by direct titration with KI as indicator. Cyanide solutions are assayed by a modification of the Chiddey method, scorifying the Pb sponge obtained by precipitation with Zn dust and Pb-acetate. Determinations on cyanide plant solutions are: free CN, total alkalinity and reducing power. Other determinations and tests, run occasionally, include: amalgamation tests, and grading tests on sand charge and residue samples. WHB(14)

Estimation of Metals in Solution by Means of Their Spark Spectra. F Twyman & C. Stansfield Hitchen. *Proceedings Royal Society*, Vol. 133, Sept. 1931, pages 72–92.

Records experiments undertaken to extend to liquids the accuracy of quantitative analysis recently attained by the spectrography of alloys. How to produce from a solution a spectrum which shall truly represent the solution, and what effect may be expected from the presence of other metals than the one under determination, are among the questions dealt with, for they must come into consideration in applying any method of quantitative spectrography of solutions. The apparatus is shown and described in detail. At the outset of the investigation, it became apparent that the older forms of sparking apparatus, used by Hartley, Pollock and Leonard and by others were unsuited for quantitative work. It was found that, owing to incrustation of the electrodes and to decomposition of the solution around them, the spark soon became unrepresentative of the bulk of the solution. The apparatus finally devised embodies 2 principles, (1) the spark takes place from liquid to liquid; (2) there is a steady feed of fresh liquid, any scum being carried away. The experiments were divided into 2 series. The first was conducted with a view to construct curves connecting lengths of lines with percentages for metals having spectra of relatively few lines, and were accordingly made with the smaller spectrograph. The elements examined were in the form of chlorides and consisted of Cu, Zn, Bi and Pb; Co is used for the internal standard. The second series of experiments was carried out using the larger quartz spectrograph; the object was to construct similar curves for metals with complex spectra, and also to note how much such curves were influenced by the presence of definite amounts of other metals. The 2 metals selected for this series were Ni and Co; Cr was used for the internal standard. The results are tabulated as well as being shown graphically. Among the advantages of this method of chemical analysis are the following: (1) The method is rapid. (2) The accuracy as regards amounts up to 0.50% is equal to that usually obtained by ordinary methods of chemical analysis, even where the chemical separations are easy. The accuracy, moreover, unlike that of an ordinary analytical determination, where stated as a percentage of the percentage present, remains constant even when the percentage is very small. Thus, for percentages less than 0.50, the spectrographic methods could usually be substituted with advantage for the chemical ones. (3) Where difficult or complicated separations are involved, the spectrographic methods often reveal unexpected errors in the chemical analysis, or discrepancies between the findings of independent analysts and in such instances the spectrographic method would appear to be the more reliable even where the chemical results are ostensibly more precise. (4) The photographed spectrum is far superior to chemical analysis speed, certainty and completeness, for making a quantitative analysis of the metallic constituents of a complex substance. (5) The spectrogram is a permanent record of the analysis. WAT(14)

Determination of Manganese with Potassium Periodate. C. F. Miller. *Chemist-Analyst*, Vol. 20, Sept. 1931, page 8.

The sample is dissolved in 15 cc. conc. H_2SO_4, 20 cc. HNO_3 and 10 cc. H_3PO_4 and diluted to 100 cc. It is then oxidized with 0.2–0.4 g. potassium periodate, boiled and placed on steam plate 5–10 minutes. After cooling, the color is matched against standards made from $KMnO_4$ solution containing 0.1 mg./cc. CEM(14)

Tin in Tin Drosses. W. M. Muldowney. *Chemist-Analyst*, Vol. 20, Sept. 1931, pages 14–15.

A 20 g. sample is decomposed in 200 cc. H_2O and 60 cc. conc. HNO_3, diluted to 400 cc. and boiled. After standing over night, it is filtered into a 1000 cc. flask. The residue is ignited and an aliquot part fused with Na_2O_2 in an iron crucible. After leaching in water, the solution is acidified with HCl and the Sn determined as usual by titration. An aliquot part of the filtrate from the 1000 cc. flask is evaporated twice with HCl, reduced with iron wire and also titrated. CEM(14)

Arc Spectrographic Estimation of Chromium in Ruby. Jacob Papish & Wm. J. O'Leary. *Industrial & Engineering Chemistry, Analytical Edition*, Vol. 3, Jan. 15, 1931, pages 11–13.

9 references. The persistence of the arc spectral lines of Cr as conditioned by concentration of the element has been studied in the range between 5785.8 and 3120.4 A. U. The study was extended to Cr in a mixture of fused chromic oxide and alumina, and it was observed that the sensitivity of the spectral reaction was much greater in the case of Cr in fused alumina than in the case of Cr when arced as chromic acid. The method was applied to the estimation of Cr in rubies. MEH(14)

A New Method for the Colorimetric Determination of Manganese. Ralph G. Harry. *Journal Society Chemical Industry*, Vol. 50, Sept. 25, 1931, page 796.

An alcoholic solution of tetramethyldiaminodiphenylmethane when added to a solution containing manganese hydroxide in acetic acid produces a deep blue coloration which fact can be used for the quantitative determination of very small amounts of manganese. VVK(14)

Methods for Determining Manganese. Roy P. Hudson. *Heat Treating & Forging*, Vol. 16, Aug. 1930, pages 1009–1010.

Gravimetric and volumetric methods for the determination of Mn are described. Volhard's process, Crobaugh's modification, the bismuthate process, the color method and the persulphate-arsenate method are given in detail. The last named is the most rapid and the most satisfactory for determining Mn in iron and steel when it is present in ordinary percentages. Ha(14)

HISTORICAL & BIOGRAPHICAL (15)

The Historical Development of the Herminenhütte at Laband, Upper Silesia during the Years 1848-1926. (**Die geschichtliche Entwicklung der Herminenhutte in Laband, O.-S., in den Jahren 1848-1926.**) C. Netter. *Stahl und Eisen*, Vol. 51, Sept. 24, 1931, pages 1189–1192.

Report 88 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. The historical development of this Upper Silesian steel mill is characteristic of the history of the other steel mills of Upper Silesia and of many others in Middle Europe. The modernization of the plant in question throughout the years 1848–1926 is described. GN(15)

Seventieth Birthday of Professor Gustav Tammann. (**Tammann zum 70 Geburtstag.**) *Zeitschrift für Metallkunde*, Vol. 23, May 1931, pages 133–146.

Dedication, followed by summaries of Tammann's scientific contributions.

Crystallization and Melting. (**Kristallisieren und Schmelzen.**) Fr. Körber. Pages 134–137.

The Investigations of G. Tammann upon the Constitution of Alloys. (**Die Forschungen G. Tammanns über die Konstitution der Legierungen.**) G. Grube. Pages 137–138.

Tammann's Studies of Cold-Work, Hardening and Recrystallization. (**Tammann's Untersuchungen über Kaltreckung, Verfestigung und Rekristallization.**) G. Masing. Pages 139–142.

The Work of G. Tammann on the Chemical Properties of Metals and Alloys. (**Arbeiten von G. Tammann über die chemischen Eigenschaften von Metallen und Legierungen.**) W. Köster. Pages 142–146. RFM(15)

The "Niello" and Enamel Technique in Art-Craft. **(Die Niello- und Emailtechnik im Kunstgewerbe.)** K. Schuch. *Oberflächentechnik*, Vol. 8, Sept. 1, 1931, page 186.

An historical sketch of the very old technique of coloring of metal surfaces. Even 3000 years ago, the Egyptians used a mixture of lead sulphate, argyrose and cuprous sulphide melted together for "niellizing." The objects to be colored were covered with this mixture and then burnt. The Niello and Tula methods were developed to a high state of art particularly in India and Russia; enamelling has been highly developed in Europe since the eleventh and twelfth centuries. Some enamel compositions are described. Ha(15)

The Historical Development of Smelting and Refining Native Copper. H. D. Conant (Calumet & Hecla Consolidated Copper Co.). *Mining Congress Journal*, Vol. 17, Oct. 1931, pages 531-532.

The various steps for refining Lake copper are discussed from the year 1847, beginning of Cu mining in Lake Superior region, up to the present. Principal impurity, As, was taken care of in 1905 by intimate mixture of soda ash and lime in equal proportions; mixture was thrown over surface of furnace charge during the blowing period. This soda ash-lime mixture is now added to the charge by being blown through iron pipes into the Cu below the surface, giving more effective and intimate contact with the arsenious oxide. Application of pulverized coal has practically prevented Cu from entering slag while melting down the mineral. With a slightly reducing atmosphere in the melting down period of the furnace cycle and oxidation of metallic copper eliminated by mixing coal or coke screenings with original charge, immediate discard of slag from the reverberatory melting furnace without blast furnace treatment was made possible. Thus, blast furnace has become unnecessary. 300 ton refining furnace with Clark casting wheels pouring 50 tons (average shape)/hr. are now used. DTR(15)

Historical Sketch of the Lake Superior Copper District. James Fisher (Michigan College of Mining and Technology). *Mining Congress Journal*, Vol. 17, Oct. 1931, pages 468-471.

A concise and vivid sketch of the Lake Superior District from the beginning of operations. It is the sole place in the entire world where native Cu has been found in any considerable quantity. Only incidents and properties have been selected that typify the district. DTR(15)

The History of Malleable Iron in Liege. **(Contribution a l'histoire de la fonderie de malléable au pays de Liége.)** R. Deprez. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 863-869. 10 references.

Traces the history of malleable in Belgium from the enunciation of the basic principles by Reaumur in 1722. Lesoinne apparently began to make malleable in 1834 to 1838. Clear records date back to the establishment of Hardy and Company in 1850. HWG(15)

ECONOMIC (16)

The Future of the Copper Industry. Arthur Notman. *Canadian Mining & Metallurgical Bulletin* No. 229, May 1931, pages 629-637.

An economic study. AHE(16)

The Metal Year 1930. **(Das Metalljahr 1930.)** Alfred Marcus. *Metallbörse*, Vol. 21, Jan. 31, 1931, pages 199-202.

The aluminum market was also affected by the business depression during the past year as evidenced in a noticeable decrease in world consumption. It was found during the past year that the increase in aluminum sales due to high copper prices is relatively small and that, on the contrary, the reduction in the price of copper did not cause a decrease in aluminum sales. During the past year, the European cartel decreased the price of aluminum £10 per ton. In Germany, the old import regulations were revised and a tariff of 25 RM. per kilogram was imposed. In Switzerland, the tariff on crude aluminum was increased from 5 to 65 Swiss francs per kilo and the tariff on rolled products was increased 60 francs, that is, making them practically prohibitive. German aluminum imports for 1930 decreased considerably over the previous year although it is difficult to determine whether it was entirely the result of the tariff or the bad business conditions. Nevertheless, the imports of crude aluminum for 1930 were 4368 tons with an export of 4903 tons, that is, the exports were a few hundred tons greater than the imports, whereas in the preceding year the imports exceeded the exports by about 3600 tons. 70% of the aluminum imports during 1930 came from Switzerland. Recently, however, German-Swiss aluminum relations have become somewhat strained. America has continued to be a strong competitor in Asia. The Americans have lowered their domestic price of aluminum since their tariff has been reduced, as has the European cartel. It would seem that the "American danger" is not as great as it has been pictured in the German and Swiss tariff debates. The decrease in production has not been one-sided. American competition did not prevent the German exports of rolled products to British India from increasing from 649 tons in 1929 to 937 tons in 1930. The exports of manufactured goods to England increased from 564 tons to 795 tons. In many other places there has been a decrease, but the total for 1930 is 4696 tons as against 4426 tons for the previous year. The exports of aluminum ware have decreased considerably from 6975 tons to 3933 tons. The exports of foil increased somewhat, namely, from 3322 to 3547 tons. China with 926 tons (as against 619 tons for 1929) was the largest customer. The imports of foil to Anglo-Saxon countries have decreased. WHB(16)

The Beryllium Problem. **(Il problema del Berillio.)** G. Panebianco. *Metalli Leggeri*, Vol. 1, May-June 1931, pages 9-11.

The beryllium problem is not primarily metallurgical, since its metallurgy does not present special difficulties, but rather one of extraction from the ore. Unless it is possible economically to utilize deposits very low in Be, the price of the metal will probably remain high. Low-Be deposits may easily exist in which the presence of Be is not known because its presence is difficult to detect analytically in the presence of Al. The absence of Be from some clays derived from Be-bearing rocks indicates that there has been a leaching in nature. This suggests the possibility of a "permutation" or base-exchange as a concentration method from silicates carrying Be. This suggestion is made by analogy and not on the basis of direct research. Be has not been studied from the point of view of light alloys, but should be. HWG(16)

The Economic Utilization of British Pig-Iron Resources. C. H. Ridsdale & N. D. Ridsdale. *Foundry Trade Journal*, Vol. 42, June 19, 1930, pages 453-454; Vol. 43, July 3, 1930, pages 7-10; July 10, 1930, pages 28-30; July 17, 1930, pages 46-47; July 24, 1930, pages 64-65; July 31, 1930, pages 82-83; Aug. 14, 1930, pages 114-116; Aug. 21, 1930, pages 129-130, 133-134; Aug. 28, 1930, pages 150-152; Sept. 4, 1930, pages 168, 170.

Paper read before the annual convention of the Institute of British Foundrymen. Includes discussion. Gives information of British pig iron resources that will enable a foundryman to select varied brands of iron for his own particular purpose as near to his own locality as possible. Data collected by circular letter to all makers of pig iron in the country asking for the latest information. Inherent properties of pig iron are given. In calculating mixtures, the method which seems to be the most reasonable is to base the quantity of metal charged per round upon the weight per ring layer of fusion coke charged. Includes tables giving composition of the district irons and names of firms handling them. VSP(16)

Economic Significance of Specifications from the Standpoint of a Us er o Steel. P. Parke (Pullman Company). *Preprint, Symposium on Economic Significance of Specifications for Materials, Proceedings, American Society for Testing Materials*, 1931, pages 11-14.

Discusses advantages of specifications in insuring uniformity, sound economic use of different grades of material, and opening up a field of fair competition. HWG(16)

The Copper Industry. Robert E. Tally (United Verde Copper Co.). *Mining Congress Journal*, Vol. 17, Oct. 1931, pages 463-466.

Excellent discussion of present economic condition of the copper industry. Major requirements for stabilizing Cu are: (1) genuine co-operation among producers of the world in reduction and maintenance of stocks at a normal basis; (2) revision of the anti-trust laws to an extent that collective curtailment, which is the only effective means for the adjustment of supply to demand, is not only permissible, but encouraged; (3) more intensive efforts toward new uses for the metal, in alloy with steel and other metals, by research; (4) marketing methods that will prevent drastic price fluctuations by the sale or purchase of small amounts of Cu; (5) orderly liquidation of excess inventories; (6) sales limited to maximum delivery of 90 days, and by agents financially interested in maintaining prices, and not by dealers and speculators; (7) consolidation of mines into large groups for the reduction of selling and other overhead expenses, and for the acquisition of refining facilities which the individual producer cannot afford; (8) cost reductions through improved metallurgical methods, and the recovery and marketing of by-products; (9) co-operation between producers and consumers, with publication of frank interchange of inventory data. The future of the industry will depend upon the character and extent of co-operation among producers and the sympathy and co-operation of the Government. DTR(16)

The Utilization of Waste Material in the Cast Iron Foundry. **(L'emploie des déchets divers en fonderie de fonte.)** E. K. Smith & F. B. Riggan. *Revue de Fonderie Moderne*, Vol. 25, July 10, 1931, pages 242-243.

The methods noted in this article as suitable for American conditions (*Iron Age*, Apr. 30, 1930) can equally well be applied to French conditions. Ha(16)

Antimony in 1930. Paul M. Tyler. *United States Bureau of Mines, Mineral Resources of the United States*, 1930, Part I, Sept. 8, 1931, pages 1-15.

Domestic consumption of Sb dropped more than $^1/_3$ in 1930. Imports for consumption were, in short tons: Ore (contained Sb), 863; liquated SbS, 713; metal, 7700; oxide, 690. From domestic and foreign ore, 13,711 tons of antimonial lead was produced containing 1685 tons of Sb. Recovery of secondary Sb was 8082 tons. AHE(16)

Gold, Silver, Copper, Lead and Zinc in Arizona in 1929. C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Resources of the United States*, 1929, Part 1, July 30, 1931, pages 765-829.

In 1929, Arizona produced $155,567,133 worth of Au, Ag, Cu, Pb, Zn, the largest production since the war and the largest production of the 5 metals for any state. Cu represented nearly 94% of the total. Au production (202,318.14 oz.) increased more than 5%; Ag output (7,543,283 oz.) increased 11%, but only 1% in value; Cu increased about 13% in quantity (to 830,628,411 lbs.) and almost 39% in value; Pb production (16,054,122 lbs.) increased about 12% in quantity and 21% in value; Zn output (2,458,580 lbs.) was 92% over 1928 in quantity and 108% in value. AHE(16)

PLANTS & LABORATORIES (17)

Ore Crushing and Sinter Plant of the Neunkircher Plant at Neunkirchen (Saar). **(Erzbrech- und Sinteranlage des Neunkirchen Eisenwerks, A. G., vorm. Geb. Stumm in Neunkirchen (Saar).)** J. Oppenheuser. *Stahl und Eisen*, Vol. 51, Sept. 17, 1931, pages 1165-1167.

This plant is equipped with top crushers of a capacity of 500 tons minette/hr., a Dwight Lloyd sintering band with a capacity of 38-46 tons/hr. The band has a width of 2 m. and a suction surface of 40 m.^{2} Figures on the power consumption of the plant are given. GN(17)

The Fabricating Shop Nord of the Neunkircher Iron Work. **(Die Zurichterei Nord des Neunkircher Eisenwerkes.)** O. Vogel. *Stahl und Eisen*, Vol. 51, Aug. 27, 1931, pages 1081-1085.

Illustrated description of the fabricating shop after its modernization. GN(17)

The Present Experimental and Testing Bureau of the German Acetylene Society in Berlin-Friedenau. **(Die jetzige Untersuchungs- und Prüfstelle des deutschen Azetylenvereins in Berlin-Friednau.)** E. Sauerbrei. *Autogene Metallbearbeitung*, Vol. 24, Sept. 15, 1931, pages 281-283.

The new bureau contains, among other rooms, a test room of about 100 m.^{2} for testing acetylene apparatus, 3 sets of Caro apparatus for carbide analysis, flow-meters for quantities of 50-50,000 liters/hr., water manometers up to 2000, mercury manometers up to 20,000 mm. water. A general description is given. Ha(17)

Forging in a Tool and Alloy Steel Plant. E. J. Poole, Jr. *Heat Treating & Forging*, Vol. 17, Mar. 1931, pages 246-249.

The layout of a forge, dimensioning of foundations for the anvil, avoidance of vibrations, construction of cylinders for steam hammers, selection of hammers and necessary operating crew are fully discussed. Ha(17)

The Quantity Production of Light Gauge Drums. E. B. Peet & W. P. Blake. *Metal Stampings*, Vol. 4, Mar. 1931, pages 207-212, 220.

Authors describe new process and production line of automatic machinery recently developed for the manufacture of corrugated, light gage, sheet steel drums at rate of 3600/10 hr. day. Also give diagrams of drum design, lock seams and end seam employed, and plan of factory layout with photographs of various machine units. JN(17)

The Laboratories of the Ore Dressing and Metallurgical Division, Mines Branch, Department of Mines, Ottawa. C. S. Parsons. *Canadian Mining & Metallurgical Bulletin* No. 233, Sept. 1931, pages 1033-1038.

Descriptive, with examples of recent results. AHE(17)

Heat Treated Pipe Couplings Solve Long Distance Gas Transportation. C. B. Phillips. *American Gas Journal*, Vol. 134, Jan. 1931, pages 56-57.

Natural gas furnaces are installed; the furnace dimensions are given; an automatic temperature control is used. The layout makes use of gravity. MAB(17)

New Heat Treatment Shop at Bethlehem. S. D. Gladding. *Heat Treating & Forging*, Vol. 16, Dec. 1930, pages 1523-1526, 1529.

The installation of electric resistance furnaces, quenching arrangements, automatic temperature control and testing equipment is fully described. Ha(17)

A Forge Plant in the Chicago Area. M. R. Chase. *Heat Treating & Forging*, Vol. 16, Sept. 1930, pages 1152-1155.

Forging equipment and practice at the plant of A. Finkl & Sons Co., Chicago, are described. Ha(17)

MACHINERY & SUPPLIES (18)

Machine Tools from the Manufacturing User's Point of View. HERBERT C. ARMITAGE. *Transactions Manchester Association Engineers*, 1929–1930, pages 265–326.

Includes discussion. The costs of production of certain components by old and by up-to-date machines are analyzed and compared and production costs generally are discussed. Among various modern machines described in detail are center lathes and the multiple type of cutting tool; drilling, milling, gear-cutting, and grinding machines; checking capstans and turret lathes, chucking automatics and electric welding machines. It is anticipated that the new cutting materials will cause small changes in machine-tool design, but the effect will be less than caused by the introduction of high-speed steel. The tendency is now toward standardized single-purpose machines; multiple-purpose machines will probably become obsolete. Tables are given showing the advantages and disadvantages of the 2 types of machine and of individual motor drive. Ha(18)

Commercial Types of Power Presses. Slide Motions Employed in Power Presses. E. V. CRANE. *Metal Stampings*, Vol. 4, Feb. 1931, pages 131–134; Mar. 1931, pages 239–242.

The reciprocating slide or ram of the average punch press is most commonly actuated by a crank which describes smooth harmonic motion. Cam actions are employed to a lesser extent for obtaining bottom dwells or for operating knockouts. Bottom dwells are also obtained by the use of a special Geneva action, which stops the press at bottom center under full load. The same stop mechanism is used in extrusion presses to remove impact shock. This greatly reduces tool breakage. Knuckle joint presses describe motion curves resembling crank motion, except for a definite flattening out at the bottom of the stroke to produce a semi-dwell. Extremely high pressures are exerted by the ram at the bottom of the stroke, resulting in a proportionately high load carrying capacity. The short working range of these presses limits their use to processes of coining, embossing, swaging, sizing and special cases of extrusion. The power screw press or percussion press, although much slower in action, resembles the drop hammer in that the work absorbs the entire energy of the slide. In the flat edge trimming press, 3 cam actions are combined for trimming square all 4 sides of a drawn shell in sequence. Cam stripper perforating presses combine an auxiliary cam motion with a crank motion. The cam actuated stripper clamps the metal positively while the crank actuated slide carrying a number of perforating punches operates to pierce the strip. JN(18)

Overhead Conveying Machinery in Steel Mills. E. T. BENNINGTON (Cleveland Crane & Eng'r'g. Co.). *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 111–114.

The use of overhead conveying machinery has expanded considerably in recent years, with resultant savings in factory space, maintenance and material handling costs. Demands for greater speeds and increased flexibility have led to the development of various special rolled shapes for rails. Materials for rails must resist wear and peening action. A specialized rail, high in C and Mn content, designed with a raised section or wearing tread, shows no sign of material wear from carrier wheels operating at 600 ft./min. The development of specialized monorail systems with electric hoists has progressed rapidly. The author illustrates the use of conveying machinery in a wire mill and in strip, sheet and tube mills. JN(18)

Vibration-Free Shaking Molding Machine with Compressing for Compressed Air Operation. (Stossfreie Rüttelformmaschine mit Pressvorrichtung für Druckluftbetrieb.) WEIL. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, July 17, 1931, pages 581–582.

Description and illustration of the machine which is operated entirely mechanically for the filling up with sand. It is built for a maximum pressure of 16,000 kg. with 8 atmospheres air pressure. Ha(18)

Rapid Acting Scrap Piling Press. (Schnell arbeitende Druckwasser-Schrottpaketierpresse.) E. SCHWENZNER. *Stahl und Eisen*, Vol. 51, Apr. 16, 1931, page 501.

Illustrated description of a new scrap press built by Demag, Duisburg. GN(18)

Reel with Automatic Switching of the Electric Driving Motor. (Drahthaspel mit selbsttätiger Schaltung des elektrischen Antriebes.) H. SCHMITT. *Stahl und Eisen*, Vol. 51, Apr. 9, 1931, pages 465–466.

A new reel for reeling rods and other small shapes which shows an entirely automatic control and offers many advantages in comparison with all previous constructions is described. GN(18)

Foundry Crane with Pig Molding Machine. (Giesshallenkran mit Masselformmaschine.) W. ROLLENHAGEN. *Stahl und Eisen*, Vol. 51, July 23, 1931, pages 936–938.

Report 121 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. The paper describes a new type of crane construction. The crane is equipped with a pig molding machine and all the other accessories in order to facilitate the handling of the cast pigs. The crane, as installed at the Norddeutschen Hütte in Bremen-Oslebshausen, can handle a production of 800–850 tons of pig iron per day. GN(18)

Experimental Investigations of a Screen Washer for the Primary Cleaning of Blast-Furnace Gas. (Recherches expérimentales sur un laveur à claies pour l'epuration primaire des gaz de hautsfourneaux.) MARCEL STEFFES & ROB. WELTER. *Revue Technique Luxembourgeoise*, Vol. 23, July-Aug. 1931, pages 145–149.

Screen washers are stationary gas cleaners with the double purpose of precipitating the dust and cooling the gas. An installation is described which treats 50,000 m.^{3}/hr. Tests show the influence of different quantities of water (100, 200, 300 m.^{3}/hr.) on the cleaning effect. The amount of gas was varied at the same time from 20,000 to 60,000 m.^{3}/hr. The conclusion is that the choice of the water ratio is determined by the cleaning effect rather than by thermal considerations. The series of tests are illustrated in curves and tables. Ha(18)

The Design and Application of Cranes to Steel Mill Service. Part 1. G. W. YANNEY (The Alliance Machine Co.). *Rolling Mill Journal*, Vol. 5, Jan. 1931, pages 53–54.

Introductory article. Gives extensive list of the types, capacities and functions of the great variety of electric cranes employed in the blast furnace, open hearth and mill departments of the modern steel plant. JN(18)

BIBLIOGRAPHIES (19)

Index to Iron and Steel Patents—1930-1931, Supplement. V. E. KINSEY & T. E. HOPKINS. American Compilation Co., Pittsburgh, 1931. Paper, 6 × 9 inches, 12 pages. Price $2.00.

Abstracts of U. S. ferrous metallurgical patents—Class 75 sub-classes 1, 14, 27, 44, 45, 46, 47, 48, 49, 50, 51, 65, 77 & 197.

Includes patentee, constituent, assignee and classification indexes.

The application date has been added to each abstract, this being the only change from the original volume.—M. L. Moorman (19)-B-

MISCELLANEOUS (20)

Reducing Torsional Vibration by Damping Devices. J. ORMONDROYD. *Machine Design*, Vol. 3, July 1931, pages 33–36.

For variable speed engines, devices must be used either to keep the vibration amplitudes of torsional vibration within small values or to place the critical speeds in regions where operation is possible but not probable. Several devices used for the purpose of eliminating these vibrations are described. Usually, ordinary (Coulomb) friction or viscous friction is used to dissipate vibration energy. The theory of the dampers is briefly given and a few constructions are described. Ha(20)

The "Dinta" System. A. MARSON. *Foundry Trade Journal*, Vol. 45, Sept. 10, 1931, pages 167–168.

An article explaining the system of industrial training of youth, now adopted by all important plants in Germany. It is stated to have been "created by industry to stop subsidies from public funds being used in industry." The 10,000 boys enrolled under it are given vocational, physical and technical training, as well as opportunities for character development. The system has also been extended to include aged and clerical workers. Its trend is toward the making of man into "the machine master, and not a machine slave." OWE(20)

Surface Hardness of Gear Teeth. A. C. RASMUSSEN. *American Machinist*, Vol. 74, June 11, 1931, pages 907–908.

The Hertz formula for determining the maximum compressive stress produced at the point of contact of 2 gear teeth under load is modified so as to take into account also the surface hardness of the tooth which governs the permissible load. Ha(20)

Lubrication and Oiliness. A. P. SACHS. *Houghton's Black & White*, Vol. 3, Apr. 1931, pages 4–8.

It is maintained that, although the quality of a lubricant can be determined in a laboratory test, its value for any given service can be ascertained only by a performance test. General specifications, therefore, can only be given for qualities covering a certain range of uses. Ha(20)

Detonation Temperatures of Acetylene. (Verpuffungstemperaturen des Azetylens.) W. RIMARSKI & M. KONSCHAK. *Autogene Metallbearbeitung*, Vol. 23, July 1, 1930, pages 211–215.

Pure acetylene explodes in the presence of an iron plate heated to 510° C. and a minimum pressure of 3.05 atmospheres and at a flow velocity of 0.4 l./mm. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 228. Ha(20)

Railroad Saves Six Times Electric Heat Cost. WIRT S. SCOTT (Westinghouse Elec. & Mfg. Co.). *Electrical World*, Vol. 98, Sept. 5, 1931, pages 423–427.

Extensive savings have been effected in the babbitting of bearings, armature and coil baking, and annealing steel castings by the Norfork & Western Railway at their Roanoke, Va. shops. Much greater exactness of heat treatment is secured, longer life of the treated parts, labor saved, etc. WHB(20)

Utilization of Scrap for New Products by Means of Welding. (Verwendung von Materialabfällen zur Neuanfertigung mit Hilfe der Schweisstechnik.) F. WECKWERTH. *Schmelzschweissung*, Vol. 10, July 1931, pages 184–186.

The manner in which scrap parts can be used again to great advantage in building up small parts, fittings, etc., by welding instead of remelting them in the furnace is demonstrated and advocated. Several examples are illustrated. Ha(20)

Salt Cellars—Old and New. Part I. Salts from 15th to 18th Century. A. FREDERIC SAUNDERS. *Metal Industry*, N. Y., Vol. 29, Aug. 1931, pages 331–332.

Examples and descriptions of the characteristics in design of old salt cellars are given. PRK(20)

Thermocouples Whose Elements Are Longitudinally and Transversely Magnetized Ferromagnetic Substances. STEWART SEASS. *Physical Review*, Vol. 38, Sept. 15, 1931, pages 1254–1257.

A ferromagnetic wire is bent at right angles to form a square U-shaped conductor. If the 2 bent ends are kept at different temperatures and the section between the 2 corners is magnetized transversely while the portions leading from the right angles are longitudinally magnetized, an e. m. f. is set up between the bends. Values for this e. m. f. for different magnetic fields are shown. Also, the relation between this effect, discovered by Sir William Thomson in 1856, and an effect discovered by von Ettingshausen and Nernst, nearly 30 years later, are indicated. WAT(20)

Internal Stresses. (Ueber innere Spannungen.) OTTO MIES. *Schmelzschweissung*, Vol. 10, Sept. 1931, pages 213–215.

The author shows that internal stresses are present in almost any technical construction and he investigates how great they are and what direction they assume. In general, the stresses occurring in modern welded constructions can be assumed not to be greater than in the types of joining materials formerly used; that is, they are usually not unduly high. Ha(20)

The Influence of Electromagnetic Waves on the Resistivity and Hardness of Metals and Alloys. (Influence des ondes électromagnétiques sur la résistivité et la dureté des métaux et alliages.) G. MAHOUX. *Comptes Rendus*, Vol. 193, July 6, 1931, pages 27–29.

Two bars of the same material—the one submitted to the direct action of an electromagnetic field, the second supported at a distance of 10 cm. from the first—were found by the author to undergo a decrease in electrical resistivity with time. After 2 hours treatment in the field, a sharp drop (followed by a recovery) of resistivity was observed. The resistivity, however, did not return to its initial value. This phenomenon was found to recur every 2 hrs. Two steels, a cast Fe, and a complex Al alloy were investigated. The bars were first polished; after having been subjected to the action of the electromagnetic field for 2 hrs., successive dark and light rings appeared on the bars, these serving to indicate the existence of nodes and loops in the bars. At the conclusion of the experiments, hardness tests on one of the steel bars showed that the hardness had increased during the experiment from 429 (Brinell) to 444 and 447, respectively, the high and low values corresponding to the nodes and loops which had been revealed by the coloring of the bar during the test. A similar phenomenon was noted in the case of the Al-alloy bars. OWE(20)

Rubber Stamp Method of Etching Metals. CHARLES H. PROCTOR. *Metals Cleaning & Finishing*, Vol. 2, Dec. 1930, pages 1069–1072.

Rubber stamp method is simplest of all used for etching metals. It gives poorest results and only certain classes of work can be etched by it. It is used very extensively for etching of steel knives. Procedure consists of coating the metal with a varnish made by dissolving gum-guaiacum in alcohol. The knives should be slightly warm. Rubber stamp is pressed down upon a piece of cotton cloth, saturated with a strong solution of KOH. The stamp is then stamped on the varnish. After the KOH is allowed to remain on the surface for about a minute, it is washed off, removing the varnish touched by it, at the same time. Etching is done by dilute HNO_3. The acid is rinsed off after etching, and the varnish is removed by treating with hot alkali. MS(20)

Statistical Control, How New Science Promotes Uniformity of Product. ANSON HAYES & R. T. PASSANO (Research Laboratories, American Rolling Mill Co.). *Metal Progress*, Vol. 20, Sept. 1931, pages 94–98.

The authors present a discussion of the use of statistical methods in attaining control of manufacturing processes. WLC(20)

On the Electric Resistance of Carbon. Z. NISHIYAMA. *Kinzoku no Kenkyu*, Japan, Aug. 1931, pages 403–415.

The experiment was carried out to explain an abnormal electric property of C which belongs to such semi-conductors as C, B, Si, Ti, Ge and Zr. With pure graphite filaments which were prepared by the deposition of C decomposed from carbon tetrachloride and treated at such high temperatures as 2500° and 3000° C., the electric resistance was measured at temperatures from 0° C. to 2000° C.; the grain size was also examined by X-rays. It was found that the grain size of the graphite was larger when it was heated at high temperatures. When the grain was very fine, the electrical resistance was far greater than that of metals, just as in the case of semi-conductors. When heated, its electrical resistance decreases first and, thereafter, it begins to increase. If the graphite was heated to 3000° C. for one hour, the electrical resistance and its thermal coefficient are nearly the same as that of metals. Thus it was concluded that C has originally the same electrical property as metals, but that the fineness of the grain causes an apparent anomaly of electrical resistance. KT(20)

The Phenomenon of Slip in Plastic Materials. A. NADAI (Westinghouse Elec. & Mfg. Co.). *Preprint, Proceedings American Society for Testing Materials*, Vol. 31, Part 2, 1931, 36 pages.

Edgar Marburg lecture before the A. S. T. M. The laws of deformation due to slip in plastic materials are traced through the behavior of heaps of sand, of iron filings in a magnetic field, through Lüders' lines in mild steel, slip lines in paraffin tested in compression and geological strata deformed by pressure. The mathematical laws governing slip are discussed at some length. HWG(20)

Recovery of Metals from Waste Materials. J. W. HINCHLEY. *Institution of Chemical Engineers, Advance Copy*, Dec. 1930, pages 59–66; abstracted in *Engineering*, Vol. 131, Jan. 2, 1931, page 26.

The author refers to the general importance of recovery and conservation of metals and then gives the detailed working out of 2 recovery processes. Those considered are the detinning of tin plate scrap by an alkaline plumbate solution and the recovery of Zn and Pb by a wet extraction process, from dumps, accumulated at works using the old English method of Zn smelting. LFM(20)

Producing 90-Degree Rounded Corners. J. L. ANDERSON. *Sheet Metal Worker*, Vol. 22, Oct. 16, 1931, pages 598–599.

Explanation of the laying out on the sheet metal for rounded corners to be welded. Ha(20)

Magnetism and the Quantum Theory. H. S. ALLEN. *Proceedings Physical Society*, London, Vol. 42, 1930, pages 372–378.

The results of the modern form of the quantum theory are reviewed in relation to the explanation which they afford of magnetic phenomena. Reference is made to the magnetic moment of the spinning electron, which appears to play an important part in the new quantum mechanics, and to the explanation of the molecular field of Weiss as originating in the quantum interaction between electrons. The necessity for taking into account the principle of relativity is emphasized in connection with the possible structure of the electromagnetic field: the quantum theory may demand 4-dimensional tubes of force in space-time. Heisenberg's principle of indeterminacy is briefly discussed. Ha(20)

National Machine Tool Builders' and Dealers' Association. C. A. HERBERTS. *Western Machinery World*, Vol. 22, Sept. 1931, pages 387–388.

The feasibility of a national association of machine tool builders and tool dealers is forcibly brought out by the author, president of the Los Angeles Machinery Dealers Association. Such constructive ideas should lead to closer coöperation, to the ultimate increase of new machinery sales throughout the country, to normal production of our master tools of industry and finally to the decrease of unemployment in the machine tool industry. WAT(20)

Electricity in the Manufacture of Steel. A. N. DIEHL. *Electric Light & Power*, Vol. 9, June 1931, pages 34–39.

A review of the uses in the whole field of steel making in drives, auxiliaries, transportation and supervision of operations. As the total electric energy required per ton of steel from coal and ore to finished product, the following figures are given for each case, exclusive of energy required for mining transportation: ingot, 30 kwh.; billets, 103 kwh.; structural material, 117 kwh.; plates, 126 kwh. A few installations are illustrated. Ha(20)

On Molecular and Atom Volumes 33. Volumes and Models of Atoms. (Ueber Molekular- und Atomvolumina 33. Atomvolumina und Atommodelle.) W. BILTZ (University of Göttingen). *Zeitschrift für physikalische Chemie*, Bodenstein Festband 1931, pages 198–210.

The 33rd communication on the subject presents substantiation for the "Steren Rule" established by the author a year ago. ("Stere" means the quotient between the volumes and the principal quantum numbers of the outermost shell). For more than one half of all elements, the following formula of approximation holds true; $v_0 = \frac{11.3\, n}{N}$, wherein v_0 = zero point atom volume, n = quantum numbers of the outermost shell, N = group number of the element in the periodic system. There is no denying that a relationship exists between the atomic-physical date of isolated atoms and the space occupied by the multiplicity of such mass particles. Divergencies are ascribed to a large variety of inter-atomic and inter-molecular forces. The data computed for the various elements—including metals—are graphically presented and collected in tables. EF(20)

The Prevention of Smoke in Metallurgical Operations. C. H. DESCH. Paper before the *Third International Conference on Bituminous Coal* in Pittsburgh, Pa.

While, in most manufacturing plants and power stations, smoke emission is avoidable and, from a public health point of view, has been suppressed by modern methods and regulations, it is maintained that certain metallurgical operations are accompanied by smoke emission which cannot be dispensed with without injury to the quality of the product; as, for instance, in the Bessemer process, but especially in heating of steel by the burning of coal to create a protective atmosphere. This question is thoroughly discussed. Other fuels cannot, apparently, give the same degree of protection of the same kind of atmosphere. The author advocates further study of this question to determine, over a sufficiently wide range of temperatures, the limits of composition within which a mixture of given gases will remain neutral towards a given steel. Metallurgists and fuel experts must cooperate. Ha(20)

Lubrication of Modern Conveyor Mechanisms. *Canadian Foundryman*, Vol. 22, July 1931, pages, 12–14.

A discussion of the principles underlying the operation of antifriction (ball or roller) as compared with plain- or sleeve-type, bearings with special reference to the characteristics which must be looked for in oils and greases for use in this connection. OWE(20)

Bearing Lubrication, Oil Film Pressure. *Lubrication*, Vol. 7, May–June 1931, pages 49–60.

Apparatus is described for studying the oil film pressure within a complete journal bearing, lubricated from one end, with respect to pressure distribution, friction coefficient, journal running position at known intensities of load, journal speed and dimensions. The test results show that the pressure distribution within the oil film differed widely from the usually accepted uniform distribution. Ha(20)

The Bending of a Thin Circular Plate. J. J. VINCENT. *London, Edinburgh and Dublin Philosophical Magazine and Journal of Science*, Series 7, Vol. 12, July 1931, pages 185–196.

A theoretical investigation of the behavior of the plate when it is supported with its rim at the same level everywhere and when the circumference of the plate is held fixed so that the radial strain is zero at the circumference. Ha(20)

Stresses Due to a Small Elliptic Hole or a Crack on the Neutral Axis of a Deep Beam under Constant Bending Moment. BIBHUTIBHUSAN SEN. *London, Edinburgh and Dublin Philosophical Magazine and Journal of Science*, Series 7, Vol. 12, Aug. 1931, pages 312–319.

A theoretical investigation developing formulas for the magnitude and location of the stresses. Ha(20)

Trends in the Junior Metal and Mineral Industries, 1930. GUY C. RIDDELL & D. M. LIDDELL. *Mining & Metallurgy*, Vol. 12, Jan. 1931, pages 41–46.

Brief review of the atomic physics, television, Ra, He, corrosion-resistant alloys, uses of Mg, light metals, Be, Ti, Zr and Hf, U metal, Tl alloys, Ce glass and dry ice. Ha(20)

Manganese in Water—Its Occurrence and Removal. R. SPURR WESTON. *Water Works & Sewerage*, Vol. 78, July 1931, pages 196–198.

Although Mn is usually present in water in only minute amounts; a few cases are reported where Mn occurred in such quantities that it interfered seriously with the ortho-tolidine test for Cl. The possibilities of occurrence of Mn are discussed and the ways for its elimination are described. Ha(20)

Lead Oleate Lubricants for Heavily Loaded Gears and Bearings. MAURICE RESWICK (Pennsylvania Lubricating Co.). *Iron Age*, Vol. 128, Sept. 24, 1931, pages 816–819.

The second of a series of articles. Lead oleate is a broader line lubricant for critical conditions of pressure and speeds. It will maintain a lubricating film beyond the breakdown point of straight mineral oil. Made up of low cold test oils, lead oleate can be used without danger of channelling or congealing at low temperatures. Using lead oleate lubricant, it should not come in contact with H_2O. Great care should be exercised in adopting lead oleate in the industrial field. Heavy viscosity lead oleate is used in the automobile and industrial fields. Extra viscosity lubricants are used in the steel industry. VSP(20)

Tolerance and Hardness of Precision Gage Blocks. Correspondence from J. ZUBKO & C. J. POND. *Metal Progress*, Vol. 19, June 1931, pages 86–87.

Comment on paper by C. M. Pond. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 277. WLC(20)

Metallurgical Applications of High-Frequency Oscillations. M. FAYOLLET. *Iron Age*, Vol. 127, June 18, 1931, page 1971.

Abstract translation of article appearing in *Aciérs Spéciaux, Métaux et Alliages*, January 1931. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 227. VSP(20)

LABORATORY APPARATUS (21)

Laboratory Furnaces and Temperature Regulators. (Fours de laboratoire et régulateurs de température.) PIERRE CHEVENARD. *Revue de Métallurgie*, Vol. 28, Aug. 1931, pages 453–468.

The temperatures available in a resistance laboratory furnace are not uniform. They depend on the manner of winding, position of the furnace type of the winding material and the influence of bars extending from the furnace during heating. The best solution for obtaining a uniform temperature lies in the use of 3 independent windings shunted to the supply of current. An example of the importance of the accurate temperature control is given in case of dilation curves obtained on drawing of several quenched steels. Two temperature control devices are described in detail, one based on the expansion of a bar inserted in the furnace; the other on the increase of length of a wire heated by a current connected through a shunt with the line feeding the heating coils. JDG(21)

Alternating Immersion Test. (Wechselbad zur Materialprüfung.) R. HEILBRUNN. *Zeitschrift für Instrumentenkunde*, Vol. 50, Oct. 1930, pages 590–591.

A simple device is described for submitting materials to alternating immersion tests in 2 different baths by a reversible clock mechanism. EF(21)

Microscopes. WILLIAM L. PATTERSON (Bausch & Lomb Optical Co.) *Metal Progress*, Vol. 18, Nov. 1930, pages 56–57.

The author describes advances in the construction of metallographic microscopes. WLC(21)

Laboratory Furnaces for High Temperature Work. N. RYLAND DAVIS & C. SYKES. *Journal Society Chemical Industry*, Vol. 50, June 19, 1931, pages 506–514.

The author describes types of small induction and resistance furnaces now available for temperatures up to 1600° C. 9 references. VVK(21)

A Laboratory Furnace for Testing Resistance of Firebrick to Slag Erosion. RALPH K. HURSH & CHESTER E. GRIGSBY. *University of Illinois Engineering Experiment Station Circular* No. 17, Oct. 1928, 18 pages.

A cylindrical furnace chamber is supported vertically on rollers and is rotated about its axis during the test. It is heated to any desired temperature with controlled atmospheric conditions by a blast burner using city gas and air, both at high pressure. Powdered slag is fed at a uniform rate through the burner and impinges with the blast on the vertical faces of the standard-sized test bricks which form the lining of the chamber. The melted slag flows down over the faces of the bricks and out through a port in the middle of the furnace bottom. By rotating the furnace, each test brick is brought successively and repeatedly into position before the burner. Identical temperature conditions and uniform slag treatment for the several bricks is thus insured. A sufficient number of samples can be tested at one time in this manner to give comparable results. 5 brands of commercial bricks were tested; the results are presented in tabular form. WAT(21)

An Electrical Nickel Furnace for Metallurgical Investigations. (Ein Nickelofen für metallurgische Untersuchungen.) H. V. STEINWEHR & A. SCHULZE (Physikalisch-Technische Reichsanstalt). *Zeitschrift für Instrumentenkunde*, Vol. 50, Mar. 1930, pages 194–197.

Advantages claimed: uniform temperature over a certain length of the furnace, attaining of the temperature desired in a very short time, no fluctuations in temperature. Utilization suggested: determinations of thermal expansion, transition points, etc. Consists of Ni-block with holes drilled into it. Nichrome resistance wire. Cooling-off speed can be regulated by blowing air through the solid Ni-block. Long time tests up to 800° C. Short tests up to 1000° C. Table with temperature gradient at various temperatures is included. EF(21)

Equipment to Draw Heating and Quenching Curves. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress*, Vol. 19, Jan. 1931, pages 87–88.

The writer describes a self-recording dilatometer for studying rapid temperature changes. Photograph shows the apparatus and a typical curve. WLC(21)

Recording the Melting Process and the Properties of the Cast Material. (Het registreezen van het smeltproces en de eigenschappen van het gegoten materiaal.) A. THOMASSEN. *De Gieterij*, Vol. 4, Nov. 1930, pages 180–184.
It is desirable to have complete daily reports on foundry practice together with chemical and physical data on the successive castings. A number of foundries might establish a central laboratory for complete physical and chemical testing. Using the same data sheets the various plant superintendents might profitably discuss the results obtained at stated intervals of time. HSvK(22)

Difficulties in Casting and Their Elimination in the Application of Low-Carbon Cast Iron for Medium-Heavy and Light Machine Casting. (Ueber Giessschwierigkeiten und deren Beseitigung bei der Verarbeitung von niedriggekohltem Gusseisen für mittelschweren und leichten Maschinenguss.) K. W. SCHMIDT. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Aug. 21, 1931, pages 672–673.
Using a small foundry as an example, the means of overcoming the difficulties due mainly to changing temperatures in pouring small quantities of material are outlined. Defects must be found by systematic investigations. By the addition of sufficient Si (about 2.8–3%), very uniform castings can be obtained. Ha(22)

The Casting of Threads. (Das Giessen von Gewinde.) W. SCHAEFER. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 22, 1931, pages 424–425.
A few typical cases where threads can be cast on to cast iron pieces are discussed. Economies can be secured in this manner. Ha(22)

Progress in Compressed Air Molding Machines. (Fortschritte in Druckluftformmaschinen.) A. SALMONY. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 10, 1931, pages 304–306.
Two types of pneumatically operated vibrating molding machines which simplify the work for the molder are described. They are made with box areas of from 1800–8000 cm.^{2} The consumption of air for each box is given to 0.025 m.^{3} at a cost of 0 03 RM for 1 cm.^{3} air. Ha(22)

Foundry Practice. JOHN A. SMEETON. *Iron & Steel Industry & British Foundryman*, Vol. 4, Aug. 1931, pages 355–360; Sept. 1931, pages 391–395, 402.
A discussion of equipment of a modern foundry used for the mass production of castings. CHL(22)

Practical Questions in Calculating the Charge. (Praktische Gattierungsfragen.) H. UHLITZSCH. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, May 29, 1931, pages 433–437.
On the basis of the cast iron diagrams of Maurer which indicates the properties of cast iron as related to the contents of C and Si, an example is calculated in detail to obtain a metal of definite characteristic. It is then shown that this diagram can be used to advantage for additions of Ni and Cr, also. Ha(22)

Some Points on the Storage of Patterns and Accessories. (Einiges über das Aufbewahren von Modellen mit Zubehör.) W. SCHWANERT. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Apr. 10, 1931, pages 300–301.
Some useful hints for the management and operation of foundries with regard to storage of patterns. Improper handling, designation and pattern rooms which are not fireproof are often the causes of considerable loss. Ha(22)

A Simplified Method for Making Special Brasses. (Sur une mode simplifie de fabrication des laitons spéciaux.) AUGUST LE THOMAS. *Revue de Métallurgie*, Vol. 28, Sept. 1931, pages 518–523.
Brasses containing, besides Cu and Zn, some alloying elements principally Ni and Mn furnish a strong and corrosion resistant material which is not expensive. In their manufacture a considerable attention must be paid to the proper composition which must be kept closely to the ratio 60–40 and 58–42 for Cu-Zn, if the best results are desired. The presence of alloying elements is accounted for by using their equivalence number in the calculation of the composition according to the above formula. For simplification of the shop practice, it is much more advantageous to add these additions in the shape of an alloy of the proper composition. Several formulas are proposed for a brass with 5% Ni and 3% Mn, one of which (16.7% Cu, 30.0% Zn, 33.0% Ni, 20.0% Mn) is particularly suitable as easy to handle and not requiring any overheating of the bath. The quality of the brass produced can be easily checked either by a fast metallographic examination or by casting a torsion test which will show by the angle of bend before fracture the composition of the metal sufficiently accurately for practical purposes. JDG(22)

Die-Casting of Brass. (Het Spuiten van Messing in Gietvormen.) P. WEISS & R. WARTENA. *De Gieterij*, Vol. 5, Mar. 1931, pages 30–34.
A description of apparatus for die-casting of brass, made by the firm of Eckert Brothers in Nuernberg (Bavaria). HSvK(22)

Cupola Melting of Brass. T. MAULAND. *Metal Industry*, London, Vol. 38, June 26, 1931, page 644; *Metal Industry*, N. Y., Vol. 29, July 1931, pages 304–305.
Paper read before the American Foundrymens Association. Cupola melting of 85–5–5–5 and 80–10–10 alloys is described. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 229. PRK(22)

Recent Progress in American Manufacture of Malleable Iron. (Progrès récents dans la fabrication Américaine de la fonte malléable.) H. A. SCHWARTZ. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 885–887.
Brief résumé. Describes status of powdered coal, oil, natural gas and electricity as fuels. Sand control, use of permanent molds, mold-conveyor systems are cited as important advances. Efforts to cut down annealing time are discussed. Use of an atmosphere of CO + CO_2 under pressure is being tried out as a means of accelerating annealing. The accelerating effect of Ni, Zn, Al, Ti and U has been demonstrated, and the use of Mo, with higher Si, accomplishes the same result without risk of mottling. Cu may be used for corrosion resistance and the use of Ni or Mo increases the strength. Embrittlement in galvanizing may be avoided by reducing Si and P or by quenching from 600° C. before galvanizing. It has been suggested that the success of the quenching method may be explained on the basis of the presence of N in the metal. The graphitization of malleable is not simply the break-up of cementite, but involves solution of cementite, diffusion of C and the deposition of C in nodules whose number depends on the conditions imposed. Speed of diffusion is the dominant factor. HWG(22)

Practical Calculations for Foundrymen. (Praktische Berechnungen des Giessereimannes.) No. 15 of Hermanns' Betriebspraxis der Eisen-Stahl- und Metallgiesserei. E. SCHÜTZ. Wilhelm Knapp, Halle (Saale), 1931. Paper, 6 × 9½ inches, 198 inches. Price 15 RM.
The calculation of dimensions necessary for hooks, core rods, mold clamps and similar things, the calculation of casting weights from blue prints, the calculations for mixing irons, determination of the cost of molten iron, and many other mathematical problems of the foundry are discussed in great detail with many illustrations. Unfortunately, few of the people in this country who might use such a book to advantage, can read German readily enough to utilize the volume.—H. W. Gillett (22)-B-

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing under this heading are prepared in coöperation with the Joint High Temperature Committee of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Cast Iron without Growth for Higher Temperatures. (Wachstumfestes Gusseisen für höhere Temperaturen.) R. Mitsche & O. v. Keil. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 6, 1931, pages 200–204; *Foundry Trade Journal*, Vol. 45, Aug. 20, 1931, page 114.

At temperatures above the critical point, cast iron shows growth which is largely ascribed to the disintegration of iron carbide (increase of volume and inner tensions) and to the α-γ-conversion which also effects a loosening of the structure. The possibilities of avoiding such growth are discussed; an alloy with approximately 6% Si does not show any growth. The tests indicate that such cast iron has the same good mechanical properties as ordinary cast iron. OWE+Ha(29)

Design of Thick-Walled Tubes Subjected to Pressure and Heat Input. E. W. Luster. *Transactions American Society of Mechanical Engineers*, Vol. 53, *Fuels and Steam Power Section*, May-Aug. 1931, pages 161–172.

With the increase in pressure and oil temperature, which have accompanied the development of distillation and cracking equipment in recent years, has arisen the need for a rational method for the design of thick tubes subjected to internal pressure and heat input. Formulas for temperature and pressure stresses in such tubes, and for calculating the optimum tube for given conditions are developed. Examples of calculations are given. The creep apparatus of the author's company is illustrated and described, and the test methods discussed. The apparatus is similar to that of the Union Carbide and Carbon Corporation. A number of the creep data published by other investigators are compared with those obtained by the author's company (Standard Oil Development Co.). Much of the article is mathematical. A study of the formulas show that rational design of thick-walled tubes to be used in elevated temperature service requires a knowledge of the physical properties of the metals used, particularly the creep characteristics. The modulus of elasticity, Poisson's ratio, the coefficient of expansion, and the thermal conductivity also enter into the equations either directly or indirectly, and must be known. It is planned to install a torsion machine by means of which the modulus of rigidity and Poisson's ratio may be accurately determined at both atmospheric and elevated temperatures. A few original data are given on the creep characteristics between 900 and 1400° F. of a 0.12–0.18% carbon steel, a low alloy Cr-Ni-Mn steel and a low-carbon 18 Cr-8 Ni steel. WAT(29)

Measurements with the Aid of Liquid Helium. IX. Resistance of Pure Metals at Low Temperatures. (Messungen mit Hilfe von flüssigem Helium. IX. Widerstand der reinen Metalle in tiefen Temperaturen.) W. Meissner & B. Voigt. *Annalen der Physik*, Vol. 7, 1930, pages 892–936.

The resistance of metals of the 4th periodic group down to Hf; of V, Ta, As, Sb and Bi of the 5th; of Cr, Mo, W, V, Se and Te of the 6th; of Mn and Re of the 7th; of Fe, Ru, Co, Rh, Ir, Pa and Pt of the 8th periodic group was determined from 273° K down to the temperature of liquid He. The characteristic temperatures of these metals were calculated with the aid of the Gruneisen resistance formula. The relation between the characteristic temperatures and the position in the periodic system is tabulated. WAT(29)

Reliability of Steel Boiler Sheets in Marine Service. Correspondence from F. G. Martin, Birkenhead, England. *Metal Progress*, Vol. 20, Oct. 1931, pages 90–91.

The writer discusses the failure of boilers under heading of their probable causes, defective material, bad workmanship, caustic embrittlement and design. WLC(29)

A Study on the Elasticity of Flexure of Iron, Copper, Gold, Silver, Platinum Silica Glass, and Nickel. (Étude sur l'élasticité de flexion, Fer-Cuivre-Or-Argent-Platine-Verre de Silice-Nickel.) A. Jaquerod & H. Mugeli. *Helvetica Physica Acta*, Vol. 4, part 1, 1931, pages 3–30.

Variations in the modulus of elasticity with temperature are given for the above materials. Elasticity-temperature curves are presented for the temperature range of 0 to 140° C. The curves for all of the materials except silica glass are similar to that of steel. Thermal and mechanical treatment produce an increase in Young's modulus, with the exception of Fe and glass which show a decrease. Hooke's law is never entirely followed even for small amounts of deformation. The phenomena exhibited by Ni are discussed. The data are presented both in graphic and tabular form. WAT(29)

Super-Cooling and Formation of Nuclei in Homogeneous Metallic Melts. (Unterkühlung und Keimbildung bei homogenen Metallschmelzen.) A. Lange. *Zeitschrift für Metallkunde*, Vol. 23, June 1931, pages 165–171.

The tendency toward super-cooling was studied in solidifying melts of Sn, Pb and Zn. A new testing method developed by the author was employed. The maximum of super-cooling amounted to 12–14° C. in all 3 metals and the correlation of duration of super-cooling with temperature was established. The problem of nuclei formation is taken up mathematically. The law governing radio-active decomposition was found to hold true in the present investigation. The relationship between crystallization velocity and number of nuclei formed is graphically given and a simple method of producing large single crystals is suggested. ET(29)

Short-Time Test for Metals under Stress at Elevated Temperatures. *Journal Franklin Institute*, Vol. 211, Mar. 1931, page 376.

Abstract from report in *Bureau of Standards Journal of Research*, Feb. 1931. In general results show that "long-time" or "flow" test cannot be satisfactorily replaced by simpler short-time test, although the latter is very valuable for preliminary studies. DTR(29)

Gray Iron Possesses Valuable Engineering Properties. *Foundry*, Vol. 59, Mar. 1, 1931, pages 72–74, 82; Apr. 1, 1931, pages 70–73; June 1, 1931, pages 54–56; Aug. 1, 1931, pages 66–69.

Recent investigations indicate that the view formerly held that gray iron is not pressure-resisting at temperatures above 450° F. is no longer tenable. High quality gray iron can be used safely at temperatures of 600–700° F. and even at 800° F. Tests at temperatures as low as the boiling point of liquid air showed that there is but slight change of tensile strength and hardness. In the design of apparatus for low temperature work, however, the thermal contraction must be taken into account just the same as the expansion in elevated temperatures. Test curves are reproduced. The electrical properties are also noted. Ha(29)

The Choice and Testing of Materials for Highly-Stressed Chemical Plant. *Edgar Allen News*, Vol. 10, Sept. 1931, page 962; *Vancoram Review*, Vol. 2, Oct. 1931, page 147.

For the construction of high-pressure reaction vessels, low C vanadium or molybdenum steels have recently been introduced because they are resistant to aging and are capable of withstanding great mechanical stresses, both at ordinary and elevated temperatures. Steels with 3–5% Ni are also used for this purpose which makes it possible to build the vessels with much thinner walls. Ha(29)

High Pressure in Chemical Industry. E. N. Gougeon. *Journal Society Chemical Industry*, Vol. 50, Apr. 17, 1931, pages 320–321.

A general economic review of industries requiring high temperatures and pressures such as the N, petroleum, natural gas and hydrogenation industries. VVK(29)

Considerations on the Löffler High Pressure Boiler From a View Point of Construction. (Considérations sur la chaudière Löffler a haute pressure au point de vue de la construction.) *Chaleur et Industrie*, Vol. 138, Oct. 1931, pages 537–546.

The steel used in the construction of tubes in the Löffler high pressure boiler is one containing 0.64% Mo. At 550° C. this steel has a creep limit of 5600–7000 lbs./in.², and a tensile strength of 84,000 lbs./in.² The elastic limit is double that of ordinary C steel. WAT(29)

Kanthal Alloy. *Revue Generale de l'Electricite*, Vol. 29, Mar. 21, 1931, pages 91B–92B.

A new alloy named "Kanthal Alloy," has been developed by Mr. H. von Kantzow, general manager of the Boulons Works at Hallstahammar (Sweden). It is an iron alloy containing aluminum, cobalt and chromium. The main characteristics of this alloy are: a high degree of resistance to heat, a low electrical conductivity, and a good capacity for both hot and cold working. It can be used for the production of sheet, tube, wire, or for the manufacture of crucibles. The melting point of this alloy is very high: 1650° C. This new alloy will find an interesting field of application in electric heating where a material of high electrical resistance and elevated resistance to the action of high temperature is required. HWG(29)

Heat Emission from the Surfaces of Cast Iron and Copper Cylinders Heated with Low Pressure Steam. A. C. Willard & A. P. Kratz. *Heating, Piping & Air Conditioning*, Vol. 3, Feb. 1931, pages 141–145.

This paper attempts to explain why a cast iron cylinder with walls 0.25 in. thick will transmit over 50% more heat than a copper cylinder of exactly the same size with walls 0.01264 in. thick, when there is low pressure steam on the inside and air on the outside of the cylinders. Note that the cast-iron cylinder wall is almost twenty times as thick as the copper cylinder wall, and that copper has a conductivity 8 times that of cast iron per inch of thickness. Although the copper wall is $8 \times 20 = 160$ times better than the cast-iron wall as a heat conductor, the overall heat transfer of the cast iron cylinder is greater than that of the copper cylinder because of the greater surface emission of cast iron. The conductivity of the metal may bear little or no relation to the amount of heat emitted from a cylinder made of that metal when filled with saturated steam and surrounded by still air. The actual metal thickness, within rather wide limits, has little or no relation to the amount of heat emitted. The surface finish is an all important factor. The resistance to heat flow from the outer surface of the metal cylinder is relatively enormous when measured in terms of the resistance of the metal wall itself. WAT(29)

Magnetic Properties of Copper-Nickel Alloys. E. H. Williams. *Physical Review*, Vol. 38, Aug. 15, 1931, pages 828–831.

The magnetic susceptibility of alloys of Cu and Ni in proportions ranging from 0.1% to 70% Ni have been studied between 20° and 600° C. X-ray examination of the alloys show that they are homogeneous solid solutions. Although Cu is only weakly diamagnetic it requires 0.8% or 0.9% Ni to neutralize this diamagnetic effect and 56% Ni is required before alloys show ferromagnetic properties at ordinary temperatures. For amounts of Ni from 1% up to 30% the alloy, while paramagnetic in most respects, does not obey any known law of paramagnetism with regard to temperature. As the temperature is increased the susceptibility first increases and then decreases, the maximum occurring in the neighborhood of the Curie point (about 400° C.) for Ni. In the case of alloys containing more than 30% Ni, the susceptibility decreases with increase of temperature for temperatures above 20° C. up to 600° C. WAT(29)

LEACHING (30)

Treating a Complex Ore. Data from Experimental Work on Ores in the Denver Laboratories of the Complex Ores Recovery Co. G. L. Oldright *Technical Paper* 499, *United States Bureau of Mines*, 1931, 101 pages.

The author gives an account of the more salient features brought out in developing a process for the treatment of the ore of the Flin Flon mine in N. Manitoba. He discusses extensive experimental results on roasting, leaching and electrolysis of solutions from an ore analyzing Cu 1.80, Zn 4.65, Fe 34.2, S 38.2, SiO_2 7.7, CaO 2.73, Al_2O_3 1.82, Pb 0.29, MgO 2.38, Mn 0.10, As 0.44, Sb 0.15%, Au 0.12 and Ag 1.7 oz./ton. AHE(30)

Milling, Amalgamation, Cyaniding. Allen J. Clark. *Engineering & Mining Journal*, Vol. 132, Oct. 12, 1931, pages 298–304.

One of the papers of a symposium on "The Homestake Enterprise." Milling in water enhances Au recovery by amalgamation and reduces ultimate residue loss. Cyanicide action is prevented by aeration before the application of cyanide treatment to the 2 parts of a classified pulp, previously ground to a degree permitting maximum metallurgical return. Adequate dewatering of slime before cyanidation by pressure filtration, is an economical and efficient step, the advantages of which deserve wider recognition. A flowsheet of mills and cyanide plants at Lead, S. Dak. and vicinity is shown. WHB(30)

Some Problems in the Treatment of Gold Ores. Staff, Division of Ore Dressing & Metallurgy, Mines Branch, Department of Mines, Canada. *Canadian Mining & Metallurgical Bulletin* No. 235, Nov. 1931, pages 1250–1261.

Problems in the treatment of Au ores of 5 classes are considered. These classes are (1) free milling, (2) free Au plus pyrite, (3) containing Cu, (4) arsenical and (5) containing interfering gangues such as graphitic material, soluble salts, etc. AHE(30)

Flotation Practice at the Calumet and Hecla. Robert M. Haskell (Calumet and Hecla Consolidated Copper Company). *Mining Congress Journal*, Vol. 17, Oct. 1931, pages 528–530.

The ores treated in Calumet & Hecla stamp mills are of 2 kinds, entirely different, (1) conglomerate and (2) amygdaloid. The former is hard and grinding through 200 mesh does not liberate it very thoroughly from gangue, while with the latter, crushing through 48 mesh gives satisfactory extraction. Conglomerate tailings are separated into plus 200 and minus 200 mesh products and only the latter is floated, the coarser sand being ammonia leached. Roughly 1000 tons primary slime, 1400 tons of reground sand and highly variable amount of reclaimed lake slime are treated every 24 hrs. Plant layouts for both types of flotation are described. Name, composition and amount of collectors, frothers and stiffeners used are given in detail. DTR(30)

REDUCTION METALLURGY (31)

Blast Furnace Progress in 1930. R. H. Sweetser. *Blast Furnace & Steel Plant*, Vol. 19, Jan. 1931, pages 101–104.

Brief review of developments and comments on the operation of a few new 1000-ton blast furnaces. The dimensions, equipment of auxiliaries and operating conditions are described. Ha(31)

Blast Furnace Theory and Practice. R. H. Sweetser. *Blast Furnace & Steel Plant*, Vol. 18, Dec. 1930, pages 1824–1826, 1828.

See *Metals & Alloys*, Vol. 2, Nov. 1931, page 287. Ha(31)

Iron Ore Beneficiation. Clyde E. Williams. *Mining & Metallurgy*, Vol. 12, Apr. 1931, pages 186–188.

The author takes the view that the Lake Superior district will continue to lead in the supply of iron ore for decades to come. The ores are beneficiated about 13$^1/_2$% by washing, drying and sintering and 25% by crushing and screening. A review is given of improved furnace practice by reducing the coke consumption of basic iron and of the various grades of lake iron ores. Ha(31)

Direct Methods for Production of Iron. (Die direkte Eisenerzeugung.) F. Wüst. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy*, Part 1, pages 481–495.

Includes discussion. Rather general discussion of methods for making wrought iron or sponge iron direct from ores. In discussion Kjerrman briefly refers to Swedish methods. HWG(31)

Heating of Blast Furnace Blast. (Ueber die Bedeutung der Erhitzung des Hochofengebläsewindes und über ihre Auswirkung auf die Ofenleistung.) F. Wüst. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33. published 1931, *Mining & Metallurgy*, Part 1, pages 449–461.

Discussion of present practice. HWG(31)

The Thin-Walled Blast-Furnaces of the Prague Ironworks Company. J. Sarek. *Engineering*, Vol. 130, Dec. 26, 1930, pages 817–820.

Condensed from paper read before the Iron and Steel Institute, Sept. 15, 1930. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 20. LFM(31)

The Tanier Zinc Furnace. (Le four Tanier.) V. Tanier. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 457–464.

The arrangement of the retorts and the general construction of the furnace are shown in sketches. Temperatures of the different rows of retorts, retort life, etc., are tabulated. The furnace produces 30% more Zn, with $^1/_3$ less fuel, and makes only half as much blue powder as the older type furnace which it replaced. HWG(31)

Reduction Experiments with Minette Ores and Sintered Products. (Reduktionsversuche an Minette- Erzen und Sintergut.) H. Siegel. *Archiv für Eisenhüttenwesen*, Vol. 4, June 1931, pages 557–564; *Stahl und Eisen*, Vol. 51, Aug. 6, 1931, pages 1005–1006.

The author studied the changes which minette ore and sintered products undergo during reduction in a manner so that the experimental conditions were similar to the actual conditions in the blast furnace. Therefore, the ores were gradually heated in 10 hrs. from 200° to 1000° C. and reduced with gas. Ore specimens were analyzed for Fe'', Fe''', Fe_3C and metallic Fe. It was found that carbide is formed directly from the ore at low temperatures (the amount increases up to 600° C.) and decreases at higher temperatures; most pronouncedly between 800° and 900° C. Remarkable amounts of metallic Fe are formed below 700° C. The formation of metallic Fe starts only when the reduction of Fe''' to Fe'' is completed. The state of reduction of ores and sintered products is alike at temperatures around 1000° C. Ores, the reduction of which is completed even at temperatures around 700° C., oxidize again at higher temperatures, so that, in all cases, the O content amounted to from 4 to 6% at 1000° C. GN(31)

Production of Lead-Tin Alloys from Tin Slag. (Die Herstellung von Bleizinnlegierungen aus Zinnschlacken.) Edmund R. Thews. *Metallbörse*, Vol. 21, Jan. 1931, pages 3–4.

Sn slags are smelted with Pb or Sn-poor alloys. A purer product is obtained by using type metal. Pb residues can be used with Sn slags to produce an alloy of 8% Sn. For alloys richer in Sn, this product is oxidized and used as raw material for the next smelt. Sulphurous ores require a preliminary roasting. The presence of much As is harmful because of the formation of viscous iron arsenides. A coking mixture containing 10–25% wood charcoal is best. WHB(31)

Metallurgy of Copper and Cobalt at Katanga. (La métallurgie du cuivre et du cobalt au Katanga.) E. Roger. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 441–456.

Unsuccessful experience with water jacketed furnaces is recounted. The oxidized copper ores are subjected to gravity concentration and flotation and the finely divided product is smelted in reverberatories. Lean ores are leached and the metal recovered by electrolysis. Flow sheets are given and many details described. Cobalt-bearing ores are smelted in water-jacketed furnaces, reducing the Cu and leaving Co and Fe in the scoria, which passes to electric smelting furnaces. Ores high in Co are subjected directly to electric smelting. The smelting process produces an alloy of Cu-Co-Fe which liquates into two separable products, a red alloy of 90–93% Cu, 3–5% Co, 3–5% Fe and a white alloy of 14–17% Cu, 35–45% Co, 35–45% Fe. The process is regulated to produce as much of the white alloy as possible, since the recovery of cobalt from it is easier than from the red alloy. HWG(31)

The Technical Position of the Zinc Industry. O. W. Roskill. *Mining Journal*, London, Vol. 174, Aug. 8, 1931, page 618; Aug. 15, 1931, pages 632–633.

The author describes the Maier process for ZnO reduction by CH_4 and the Coley process for reduction with nascent C from decomposed hydrocarbon oil. Other recent advances are briefly described. AHE(31)

Investigations of Japanese Magnetic Iron Sands. S. Umezu. *Proceedings World Engineering Congress*, Tokyo, 1929, Vol. 33, published 1931, pages 605–638.

In English. The titanium oxide in these sands is in solid solution or present as an intergrowth so that it was found impossible to eliminate more than 50% of the TiO_2 by magnetic separation. Difficulties in reduction due to TiO_2 are commented on. Good micrographs of the ores are shown. HWG(31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Japanning and Enameling Plant Meets Varied Schedules with Automatic Gas-Fired Ovens. J. B. Nealey (American Gas Association). *Automotive Industries*, Vol. 64, Apr. 1931, pages 582–583.

Ovens are heated indirectly with separate gas-fired heaters, and the hot products of combustion are forced into ovens with motor fans. Work is first put through a burnoff oven to free material of grease, etc. The burnoff oven, a box-like structure of sheet steel and asbestos, is heated directly; temperature of 600–700° F. is used; the burnoff period varies from 15 to 20 mins. This is followed by sanding and wiping. First coat work is baked on in 3 semi-automatic ovens after the material has been dipped in dull finish japan of 29° Be. The second coat is applied and baked on in the fully automatic oven, after being dipped in 30.5° Be japan. All air admitted to the dipping enclosure is filtered and washed while its temperature is automatically controlled by unit heaters. DTR(32)

Enameling of Cast Iron. (L'émaillage de la fonte.) Try-Chalons. *Revue Fonderie Moderne*, Vol. 25, Aug. 25, 1931, pages 305–309.

A detailed description of the production and preparation of pieces suitable for enameling, the preparation of the enamel and the application of the enamel to the cast iron. Wet and dry processes and heating and drying are discussed. Ha(32)

The Modern Painting Method with the Spraying Gun. (Das neuzeitliche Anstrichverfahren mittels der Spritzpistolen.) A. Karsten. *Oberflächentechnik*, Vol. 8, July 21, 1931, pages 153–155.

The development and modern equipment of different manufacturers is described. The pressures applied vary between 1.5 and 3.5 atmospheres. Ha(32)

The Causes of Blisters and Pinholes in Wet-Process Cast Iron Enamel. (Ueber die Ursachen von Blasen und Nadelstichen in Gussnassemaille.) Walter Kerstan. *Giesserei*, Vol. 17, Oct. 3, 1930, pages 965–972.

Plant and laboratory experiments to determine the causes of blisters and pinholes in cast Fe enamels produced by the wet-process. These defects are shown to be due to the simultaneous action of various causes, principal among which are: (1) incorrect composition of the frit, (2) physical defects in the cast Fe, (3) insufficient cleaning of the casting surface and (4) various changes in the Fe structure during the baking of the enamel. Cast Fe in which the graphite is finely divided is the most stable during baking and shows the least change in structure during the enameling process. (32)

Lime Process for Coating Aluminum. Leon McCulloch. *Metal Cleaning & Finishing*, Vol. 2, Oct. 1930, pages 863–864.

From paper read before the American Electrochemical Society. See *Metals & Alloys*, Vol. 1, Feb. 1930, page 390. MS(32)

The Advantage of Thin Organic Protective Coatings. (Der Vorteil dünner organischer Schutzschichten.) P. Nettmann. *Korrosion und Metallschutz*, Vol. 7, June 1931, pages 164–165.

Scientific problems involved in extremely thin surface layers are considered. EF(32)

The Standardization of the Painting Methods in the Manufacture of Automobiles of the Adler Works. (Die Rationalisierung der Lackierverfahren des Automobilbaues der Adlerwerke.) E. Jurthe. *Automobiltechnische Zeitschrift*, Vol. 34, Sept. 30, 1931, pages 601–604.

A description of the mechanical dipping in lacquer is given and a comparison between manual and mechanical methods. Even at 33$^1/_3$% of the full capacity of the plant, a saving of 47.5% can be obtained by the mechanical method. Ha(32)

Rubber Pipe Lining Minimizes Pulp Abrasion. D. D. Homer. *Engineering & Mining Journal*, Vol. 132, Oct. 26, 1931, pages 367–368.

For the transport of tailing, a metal pipe lasted for the passage of 1000 tons, and extra heavy metal pipe for 2000 tons. A rubber-lined pipe showed negligible wear after the passage of about 250,000 tons. WHB(32)

Paint Coatings in Aviation and Their Testing. (Anstrichmaterialien für den Flugzeugbau und deren Prüfung.) O. Merz. *Korrosion und Metallschutz*, Vol. 7, Sept. 1931, pages 217–218.

The various lacquers on the market, their properties, advantages and disadvantages, utilization, etc., are critically discussed with reference to aviation purposes. The paper was presented before the Reichsausschuss für Metallschutz, May 1931. EF(32)

Spraying Finish Coat Sheet-Steel Enamels. *Better Enameling*, Vol. 2, 1931, pages 14–17.

The equipment necessary and the importance of the proper consistency of the enamel are discussed and rules for spraying are given. WAT(32)

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

201 **Jig Borers.**—A 32-page booklet of performance data on Swiss High Speed Precision Borers has been sent out by the R. Y. Ferner Co., Washington, D. C. The book is fully illustrated.

202 **Lead.**—The November issue of this publication of the Lead Industries Association, Graybar Building, New York, contains accounts of a number of novel and interesting uses of lead.

203 **Heat Treating.**—An article "Flexibility in Heat-Treating" has been reprinted from *American Machinist* by the Hevi Duty Electric Company, Milwaukee, Wis. Copies may be obtained from the company.

204 **Heat Treating Furnaces.**—Bulletin No. 322 of the W. S. Rockwell Co., 50 Church St., New York, is devoted to their rotary hearth furnaces for heat-treating and forging ferrous and non-ferrous metals. They may be either electric or fuel-fired.

205 **Return Bends.**—Several different types of Ohiolock Frictionless return bends are illustrated in a folder sent out recently by the Ohio Steel Foundry Co., Springfield, Ohio.

206 **Thermometer Controllers.**—Bristol's thermometer controllers for ranges up to 1000° F. are listed in their catalog No. 2025. Their new recorder controllers are also illustrated in this catalog. A price list accompanies it. The Bristol Company, Waterbury, Conn.

207 **Alloy Cast Iron.**—A leaflet issued by the Driver-Harris Co., Harrison, N. J., advertises their "Nichrome" B for addition to cast iron in the making of cylinder blocks, pistons, brake drums, engine sleeves, etc.

208 **Manganese Steel.**—A recent issue of *The Amsco Bulletin*, sent out by the American Manganese Steel Co., Chicago Heights, Ill., is devoted to a variety of applications of manganese steel. Performance data are given.

209 **Electric Telemeters.**—Bulletin No. 27 of the Baldwin-Southwark Corp., Philadelphia, Pa., is descriptive of a group of testing and measuring devices all based on the use of carbon-pile resistors for the measurement of small motions. A technical discussion of the adaptations as well as the limitations of the carbon-pile resistor is included.

210 **Pyrometers.**—The Pyrometer Instrument Co., 103 Lafayette St., N. Y., has issued several leaflets and pamphlets on their new simplified optical pyrometer. Their Bulletin No. 20 explains the principle on which these instruments work and gives directions for using them.

211 **Furnaces.**—The Surface Combustion Corp., Toledo, Ohio, has prepared an attractive pamphlet by collecting a number of their ads which appeared in 1931 and printing them under one cover. Many applications of their special furnaces are shown.

212 **Fire-Brick.**—Mono-line, a plastic fire-brick manufactured by Quigley Company, 56 West 45th St., New York, is described in a booklet issued by the company. Its various uses are illustrated. Another booklet put out by them is devoted to their acid-proof cement.

213 **Steels.**—Wheelock, Lovejoy & Co., Inc., Cambridge, Mass., have prepared a number of leaflets, one devoted to each of their steels. These leaflets give the composition, physical properties, heat treatment, instructions and uses of the steel in question. They are punched for filing in a pocket size note book.

214 **Electric Furnaces.**—Bulletin No. 7 of the Ajax Electrothermic Corporation, Trenton, N. J., is devoted to the Ajax-Northrup oscillator or spark-gap type converters and furnaces. It discusses the general principles of this equipment and is profusely illustrated.

215 **Industrial Regulators.**—The Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., has published a condensed catalog on their electric motor operated valves to regulate the flow of steam, air, water, gas, oil, etc. Separate bulletins fully describing the operation of each device can be obtained from the company.

216 **Recuperators.**—Bulletin No. 3114 of the Duraloy Co., 26th St., Pittsburgh, Pa., contains information valuable to users of furnace recuperators wherein extremely high temperatures are involved. Cross-section diagrams of this type of recuperators are given.

217 **Electro-tinning.**—A compact booklet compiled by the Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y., contains information on the composition and preparation of the sodium stannate-acetate solution, operating conditions, methods of control and other data of interest on the electrotinning process.

218 **Machine Tool Castings.**—The December issue of *Nickel Cast Iron News*, published by the International Nickel Co., 67 Wall St., N. Y., features an article entitled "Better Machine Tool Castings." It also contains No. 10 of their Intimate Chats on Metallography.

219 **Gas Furnaces.**—Bulletin No. 16 of the American Electric Furnace Co., 27 Von Hillern St., Boston, Mass., is devoted to the Juthe gas furnaces with atmospheric control. A section plan of the furnace is shown.

220 **Rhodium Plating.**—The H. A. Wilson Co., 97 Chestnut St., Newark, N. J., has recently printed a pamphlet on their rhodium plating solution. They are prepared to furnish a small plating outfit for a moderate price.

221 **Inhibitor Acid.**—A folder describing their Inhibitor Acid has been issued by the Merrimac Chemical Co. Inc., Boston, Mass.

222 **Thallium.**—The January issue of the *Industrial Bulletin*, published by Arthur D. Little, Inc., Cambridge, Mass., contains a short item on this rare element.

223 **Facts on Soldering.**—A most attractive booklet compiled by the Kester Solder Co., Chicago, Ill., contains much information on soldering. Some of the chapter headings are Fluxes, Solders, Soldering Equipment and Applications of Solders and Flux.

224 **Roll Lathes.**—Bulletin L-1201 of the United Engineering and Foundry Co., Pittsburgh, Pa., is devoted to their heavy duty roll lathes. Excellent illustrations and cross-section diagrams of the equipment make this an unusually interesting pamphlet.

225 **Gage Blocks.**—C. E. Johansson, Inc., Division of Ford Motor Co., Detroit, Mich., has recently issued a catalog on their gage blocks and accessories. These gage blocks are said to be accurate within a few millionth parts of an inch. A price list is included.

226 **Optical Instruments for Examining and Analyzing Metals.**—A 125-page book prepared by the Bausch & Lomb Optical Co., Rochester, N. Y., is an optical handbook for the metallographer, including articles, tables and references compiled by their Scientific Bureau. It includes very complete optical information for the metallographer, as well as a discussion of ultra violet photomicrography and an article on spectrographic analysis.

227 **Lead.**—The January issue of this publication of the Lead Industries Association, Graybar Building, New York, features an article on lead pipe with compression fittings. It also describes the use of lead walls as a protection against X-rays.

228 **Springs.**—The December issue of *Mainspring*, published by the Wallace Barnes Co., Briston Conn., contains the second installment of an article on "Flat Springs." Charts and tables add to the usefulness of this discussion.

229 **Hack Saws.**—A leaflet sent out by Joseph T. Ryerson & Son, Inc., Cambridge, Mass., includes a list of their high speed hand and power blades.

230 **Furnaces.**—Bulletin No. 220 of H. O. Swoboda, Inc., Pittsburgh, Pa., illustrates their "Falcon" Straight Line Continuous Electric Furnaces arranged for hardening and tempering strip steel.

231 **Castings.**—The December issue of *Better Castings* issued by the Niagara Falls Smelting & Refining Corp., Buffalo, N. Y., contains a list of their alloys with suggested uses for each one.

232 **Temperature Controls.**—Bulletin No. 1212 of the Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia, Pa., is devoted to their time cycle contractors of several types: The manually operated cycle stop type, the semi-automatic cycle stop type, the automatic cycle repeating type and the cycle program type.

233 **News about Anaconda Metals.**—The January issue of this periodical which is sent out by the American Brass Co., Waterbury, Conn., contains a number of articles discussing the uses of Everdur and different types of bronze.

234 **Grinding.**—The November issue of *Grits & Grinds*, house organ of the Norton Company, Worcester, Mass., has in it several interesting articles: Gauges Increase Grinding Production and Reduce Scrap Work, Effect of Grinding Pressures on Bakelite and Rubber Snagging Wheels, and Laps and Lap Care for Accurate Work.

235 **Piping.**—A recent issue of the *National Bulletin*, a publication of the National Tube Co., Pittsburgh, Pa., features a well-illustrated article "National Pipe for Power Piping." Several pages of the Bulletin are devoted to tables showing the properties of supersaturated and superheated steam.

236 **Metal Melting.**—The use of the Kemp Immersion melting equipment is recommended for melting such soft metals as lead, tin, pewter, type metal or solder. According to this system the heating units are placed inside of the metal to be melted instead of outside of the pot which is said to effect great economy and efficiency.

237 **Bonding Material.**—The General Electric Co., Schenectady, N. Y., has sent out reprints of an article which originally appeared in their *General Electric Review*. It is entitled "Glyptal in the Foundry" and discusses the advantages of this material as used in making cores in the foundry.

238 **Furnaces.**—The American Electric Furnace Co., Boston, Mass., has recently issued a folder describing their high speed electric furnace with controlled atmosphere. A diagram shows how the atmospheric control works.

239 **Promal Castings.**—The Link-Belt Co., Indianapolis, Ind., is distributing an attractive book devoted to Promal castings. Promal is a metal suitable for many industrial castings and is described and illustrated in this new book, No. 1250.

240 **Udylite.**—The December issue of *The Udylite News*, published by the Udylite Process Co., Detroit, Mich., tells about the use of this rust-proofing process in fire-alarms and in steel lockers.

241 **Furnaces.**—Leaflet GEA-1495 of the General Electric Co., Schenectady, N. Y., discusses their Bell-type furnaces for bright-annealing coiled steel strip. Leaflet GEA-1324A is devoted to their air-draw furnaces for the quantity drawing of steel parts at temperatures up to 1200° F.

242 **Lead.**—The February issue of the Copper & Brass Research Association Bulletin illustrates the application of lead-coated copper to roofings on various types of important buildings throughout the United States.

243 **Electric Heating Equipment.**—Catalog 247 of the Westinghouse Electric & Mfg. Co., is a most useful 100-page bulletin devoted to their electric furnaces, ovens, melting pots, heating elements and heating controls. Each item is illustrated and is accompanied by production curves and specifications. The first few pages give useful definitions of terms relating to heat treatment operations.

244 **Material Handling.**—Data Sheet No. 5 of the Link-Belt Company, Chicago, Ill., contains a chart giving sizes of shafts for combined torsion and bending.

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METALS & ALLOYS, 3619 Forbes St., Pittsburgh, Pa.

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ALPHABETICAL INDEX TO ADVERTISERS

*"MA" refers to Current Metallurgical Abstract Section. "A" refers to Advertising Section.

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Frederick Samuel Jordan, sales manager of the nickel department of the International Nickel Company, Inc., 67 Wall Street, died suddenly on Dec. 16, 1931, of a cerebral hemorrhage at his home, 30 Fifth Avenue, after an illness of less than a day. Mr. Jordan was 62 years old.

Born in Berea, Ohio, on Aug. 28, 1869, Mr. Jordan attended the Cleveland Business College and commenced his career when he was 18 in the Cleveland offices of the Big Four Railroad. A year later he became private secretary to H. P. McIntosh, an executive of the Canadian Copper Company. The company merged into the organization of the original International Nickel Company in 1902 and Mr. Jordan came to New York as a sales executive.

Mr. Jordan was a member of the Bankers' Club, the North Hills Golf Club and the Ohio Society.

On recommendation of the Board of Awards, the Board of Directors of the American Foundrymen's Association has approved the presentation of the W. M. MacFadden and John A. Penton Gold Medal Awards to Dr. H. W. Gillett, Director of Battelle Memorial Institute, Columbus, Ohio, and L. W. Spring, Chief Chemist and Metallurgist, Crane Company, Chicago, respectively, for their outstanding services to the foundry industry. These two medal awards, which will be presented at the 1932 convention of the A. F. A. at Philadelphia next May, are two of four medal awards which were established through grants of funds by four post officers of the A. F. A. in 1920. The Board of Awards, which selects the recipients of these medals, consists of a committee of seven past presidents of the Association. Mr. Spring is a member of the Editorial Advisory Board of METALS & ALLOYS.

GENERAL (0)

Metallurgical Fundamentals Present and Future. Chas. G. Maier. *Mining & Metallurgy*, Vol. 12, June 1931, pages 280-284.
The author emphasizes the necessity of accurate and complete knowledge of the properties of matter and of the energy involved in physical and chemical changes because this is the first requisite of metallurgical progress. The training of metallurgists should primarily follow these lines. These ideas are illustrated by examples of application of theory, later verified by experiment. Ha (0)

Chemical Composition as a Basis for Classifying Steel Castings. R. A. Bull. *Iron Age*, Vol. 128, July 16, 1931, pages 174-175, 207.
The adoption of definite chemical limitations for the definition of products of the steel foundry is suggested instead of the present indefinite designations such as "low carbon," "high-alloy," "regular alloy steel," etc. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 321. Ha (0)

The Distribution of the Platinum Metals in the Earth-Crust (Die Häufigkeit der Platinmetalle in der Erdrinde). I. & W. Noddack, *Zeitschrift für physikalische Chemie*, Bodenstein Festband, 1931, pages 890-894.
The investigators extended their research work on the geo-chemistry of Rhenium (see *Metals & Alloys*, Vol. 2, Nov. 1931, page 241) to the analyses of the Pt-metals in their carefully collected samples and computed therefrom the distribution of the Pt-metals in the cosmos. The share of the metals listed in Column 1, in the sun's system is given in Column 2 in the table below, whereas Column 3 collects the occurrence on this earth. Column 4 shows the "impoverishment factor," i.e. the ratio between the contents of the Pt-metals in the center parts of the earth and the earth crust. The data evaluated are confronted with former statements of other scientists and are critically discussed.

Metal	Occurrence in the cosmos	Occurrence on the earth	"Impoverishment Factor"
Ru	9×10^{-6}	1.8×10^{-8}	500
Os	3.9×10^{-6}	3.2×10^{-8}	122
Rh	1.9×10^{-6}	2.2×10^{-8}	86
Ir	0.9×10^{-6}	2.1×10^{-8}	43
Pd	7.0×10^{-6}	1.2×10^{-8}	583
Pt	7.0×10^{-6}	5.0×10^{-8}	140

EF (0)

Chemical Engineering Catalog. Chemical Catalog Company, New York, 1931. Cloth 9x12 inches, 1017 pages. Price $3.00. Free of charge to operating officials subject to return upon publication of new edition.
The Sixteenth Annual Edition of the Chemical Engineering Catalog sustains the high standards established by preceding issues. The sections of this volume are the same as those last year, namely: 1. Alphabetical list of firms cataloged. 2. Trade Name Index. 3. Classified Index of Equipment and Supplies. 4. Equipment and Supplies Section. 5. Classified Index of Chemicals and Raw Materials. 6. Chemicals and Raw Materials Section. 7. Technical and Scientific Books Section.
The material contained in these sections has been carefully cross-referenced and is a convenient source of information for those interested in machinery, laboratory supplies, heavy and fine chemicals and equipment.
M. L. Moorman. -B-(0)

Transactions of the American Institute of Mining & Metallurgical Engineers, Petroleum Division, 1931. Institute of Mining & Metallurgical Engineers, New York, 1931. Cloth, 6x9½ inches, 657 pages. Price $5.00.
This volume contains 65 papers covering much of the newer technical information on unit operation, petroleum engineering, research engineering, economics and world production. These papers were presented at the 2 fall meetings of the Petroleum Division, A.I.M.E., held in Tulsa, Oct. 2 and 3 and Los Angeles, Oct. 17, 1930, and the annual meeting in New York City in Feb. 1931. -B-(0)

The Open Hearth versus the Steel Plant. *Blast Furnace & Steel Plant*, Vol. 18, Oct. 1930, pages 1619-1623.
The quality of the steel supplied by the open hearth to the steel plant for further manufacture is the basis of the entire steel trade. The consumer frequently abuses his steel beyond the proper limits, causing serious defects. The quality of steel made in the open hearth depends on the kind of scrap charged, percent of scrap, delivery of hot metal to the open-hearth furnace when needed, amount and kind of limestone used, fuel, evenness of flow of fuel, attention and ability of operators and pit practice. In the steel plant, the determining factors include the proper timing of delivery to soaking pits, rolls, reduction in rolling with regard to temperature of the ingot, temperature control, etc. All of these factors are briefly discussed. Ha (0)

Metals and Alloys. Louis Cassier Co., Ltd., London, 1931. Cloth, 6x9 inches, 136 pages. Price $2.65.
The previous edition contained the percentage compositions of some 500 metals and alloys, while the present book lists about 3500 alloys. The listing is alphabetical beginning with accumulator metal (which on this side would be storage battery lead), and ending with ziskon, a metal containing 40% Zn and 60% Al. In many instances the alloys are listed under a collective head, and under a trade name. For example under acid resisting alloys the name ferron appears and it is found also in its proper place alphabetically.
While the book is entitled *Metals & Alloys*, the headings of the tables giving the compositions are "Percentage Compositions of Nonferrous Alloys" which would lead one to believe that only nonferrous alloys are listed. However, quite a number of alloys containing 50% and over of Fe are mentioned such as calite, Krupp V2A steel, etc. R. Rimbach (0)-B-

Developments in Ferrous and Non-Ferrous Metallurgy during 1930. H. M. Boylston. *Fuels & Furnaces*, Vol. 9, Jan. 1931, pages 19-31.
A review of progress made in materials and equipment in this field. Ha (0)

PROPERTIES OF METALS (1)

The Electric Conductivity of Copper (Ueber die elektrische Leitfähigkeit von Kupfer). G. Elsner & P. Siebe. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Feb. 28, 1931, page 267.
See *Metals & Alloys*, Vol. 2, May 1931, page 94. Ha (1)

Valence Forces in Lithium and Beryllium. J. H. Bartlett, Jr. & W. H. Furry, *Physical Review*, Vol. 38, Nov. 1931, pages 1615-1622.
With the nodeless wave functions of Guillemin and Zener, the method of Heitler and London is applied to determine how 2 normal Li atoms, and also 2 normal Be atoms, influence each other (as a function of the distance). For the diatomic Li molecule in the ground state, the equilibrium distance is calculated to be 2.4A.U., and the heat of dissociation to be 1.09 volts. The experimental values are 2.67A.U. (Harvey and Jenkins) and 1.14 volts (Loomis and Nusbaum), respectively. 2 normal Be atoms repel each other. WAT (1)

Ultraviolet and Light Reflecting Properties of Aluminum. A. H. Taylor & Junius D. Edwards. *Journal Optical Society of America*, Vol. 21, Oct. 1931, pages 677-684.
3 methods of etching Al are described: with hydrofluoric acid, with sodium-hydroxide-sodium fluoride and with sodium hydroxide-sodium chloride-hydrofluoric acid. All 3 produce partially diffusing surfaces with high reflection factors for both light and ultraviolet radiation. For the former, the factors range between 82 and 87% and for ultraviolet radiation at λ 2967 from 81 to 82%. A table of diffuse reflection factors for differently treated samples of Al is given. 8 references. Ha (1)

Elastic Modulus, Temperature and Melting Point of Metals (Elastizitätsmodul, Temperatur und Schmelzpunkt). W. Widder. *Physikalische Zeitschrift*, Vol. 32, Apr. 1931, pages 349-351.
The change of the elastic modulus as a linear function of the temperature, which at the melting point is zero, was established in earlier work by the author. The original relation $E_t = A \cdot e^{-\frac{B}{T - t}}$ was compared with results of recent measurements by a number of investigators over a wide temperature range. Values of the constants were calculated by the method of least squares for Fe, Ni, Al, Au, Pb, Sn, Ag, and Pt. (1)

Lead. G. W. Thompson. *Mining & Metallurgy*, Vol. 12, Apr. 1931, pages 195-198.
The growth of consumption due to electrical and automotive industries, the Harris process of softening lead, improvements in cable sheathing, hardness are discussed and explained. Ha (1)

The Change of Electric Resistance of Purest Electrolytic Iron in Transverse Magnetic Fields (Die elektrische Widerstandsänderung von reinstem Elektrolyteisen in transversalen Magnetfeldern). O. Stierstadt. *Zeitschrift für Physik*, Vol. 67, Feb. 25, 1931, pages 725-742.
It can be assumed that the total changes of resistivity of a ferro-magnetic material are due to 2 causes. One occurs in any metallic conductor and increases the resistance in longitudinal and transverse fields. The other is specifically for ferro-magnetic materials and produces a reduction of the resistance. The change depends on the temperature and, therefore, the temperature will determine whether one effect or the other will be the stronger. At the Curie point, the second effect is more powerful; at lower temperatures, the former effect, so that even the sign may be changed. Ha (1)

Hall Effect in Liquid Metals (Halleffekt in flüssigen Metallen). J. Kikoin & Ibrahim Fakidow. *Zeitschrift, für Physik*, Vol. 71, Aug. 29, 1931, pages 393-402.
Statements are frequently met in literature that the Hall effect does not exist in metals. Experiments with Hg and K-Na alloys showed, however, that the Hall effect could be observed in metals and is of the expected order of magnitude and sign (—) in K-Na alloys; in Hg, it is immeasurably small. JGT (1)

Beryllium, a New Industrial Metal. J. Becker. *Engineering Progress*, Vol. 12, Oct. 1931, pages 229-230.
Beryllium, atomic number 4, density 1.84, melting point 1280° C., is harder than glass. It is usually used now in alloys with Cu, Co and Ni; the Be content does not exceed 3%, so the present high price of Be is not prohibitive. Heat treatment improves the toughness. Beryllium bronzes, especially heat-treated, are much stronger than aluminum bronzes and approach the strength of good spring steel. Beryllium bronze has a high elasticity and shows very little sign of fatigue. The electrical conductivity of a 2.5% bronze is about 17 to 19 as compared with 7 to 10 of phosphor bronze; its thermal conductivity is 0.4 (electrolytic copper is 1). A bronze with from 0.9 to 1.5% Be has been found to be excellently adapted as a bearing metal because it showed only about 1/6 of the wear of tin bronze. Ha (1)

A Revision of the Atomic Weight of Thallium. Henry Aird Briscoe, Suetaro Kikuchi & John Buttery Peel. *Proceedings Royal Society*, Vol. 133A, Oct. 1931, pages 440-457.
The results are closely comparable with the data of Hönigschmid, Birckenbach and Kothe, both in the value of the atomic weight deduced and in the deviation of individual analyses from the mean. Their final value deduced from 24 analyses, is Tl = 204.39 with an average deviation from the mean $\pm$ 0.012, while the value reported in the present paper is Tl = 204.34 with an average deviation $\pm$ 0.015. The method employed amounted simply to fusing thallium chloride.
WAT (1)

Hafnium and Rhenium, or the Metals of the Future. *Technology Review*, Vol. 33, July 1931, page 459.
The practicability of the 2 new elements concerns the high melting point and electronic emissivity of Hf which is used in radio tubes, incandescent electric lamp filaments and cathode surfaces of X-ray tubes and rectifiers. Its cost is $25/g. The melting point of Re, 3440° C., makes it very useful in radio and television apparatus, but it also is very expensive. MAB (1)

Aluminum Bronze Die-Castings. *Metallurgia,* Vol. 4, Oct. 1931, pages 171, 172, 200.

Permanent mold aluminum bronze castings weighing from 1 oz. to 10 lbs. are now being produced. The alloys containing from 10 to 12% Al are resistant to many corrosive agents. They are also susceptible to heat treatment. A 10% Al alloy has a tensile strength of 30-35 tons/in.^{2} and an elongation of 15 or 20% in 2 ins. After quenching from 900° C., it will have a strength of 48 tons/in.^{2} with an elongation of 2% and, after tempering at 800° C., the strength will fall to 38 tons/in.^{2} while the elongation increases to 34%. No dressing is used on the molds and, with careful handling, the molds should last for at least 10,000 or 15,000 castings. Cast iron is usually used for the molds but alloy steel dies have a longer life. JLG (2)

Torsional Strength and Torsional Rigidity of Aeroplane Parts (Die Verdrehfestigkeit und Verdrehsteifigkeit von Flugzeugbauteilen). Heinrich Hertel. *Luftfahrtforschung,* Vol. 9, Aug. 1, 1931, pages 1-56.

The purpose of this investigation was to determine the torsional rigidity and the elastic axis of the constructional parts of aeroplanes. The test pieces are preferably made of materials used in the construction, i. e., woods and light metals, and have the usual sections, i. e., boxes with thick and thin walls, pipes with and without intermediate walls and with perforated walls. On the basis of these tests and of calculations, directions are given which make an exact and simple determination of the torsional rigidity and torsional tensions of these bodies possible. The rotation axis of the bodies is also determined. Part of the tests have been carried through until fracture occurred; the various shapes of fractures and their causes are described. The torsional rigidity is the product of the twisting resistance which depends only on the section; the modulus of shearing is purely a property of the material. By systematically changing the sections in the tests with wood, the modulus of shearing for wood, so far unknown, was determined for parallel and diagonal arrangement of the fibres. Only very great deviations from normal temperatures and humidity had an appreciable influence on the modulus of shearing of the wood. The torsional rigidity of the constructional parts is of determining influence on the total rigidity and the vibration properties of the plane. The test methods, their theoretical principles and the results are described in detail. A list of literature is appended. Ha (2)

Monel Metal: Production, Properties and Applications. Norman C. Marples. *Chemical Age,* London, Vol. 22, Mar. 22, 1930, pages 263-264.

Physical and mechanical properties, corrosion resistance, applications in the chemical industries and miscellaneous uses are discussed. VVK (2)

Engineering Silver Solders. *Metallurgist,* Feb. 1931, pages 23-24.

The Ag-Cu-Zn alloys are thoroughly discussed, particularly the work of Shuzo Ueno (*Memoirs College of Science Kyoto Imperial University,* Vol. 12, 1929, pages 347-374) who gives a complete equilibrium diagram; and of R. H. Leach (*Proceedings American Society Testing Materials,* 1930) who gives the physical properties of these alloys. VVK (2)

The Dimensional Stability of Heat-Treated Aluminum Alloys. J. D. Grogan & D. Clayton. *Journal Institute of Metals,* Vol. 45, No. 1, 1931, pages 157-186; condensed in *Engineering,* Vol. 131, Mar. 13, 1931, pages 371-373; abstract in *Engineer,* Vol. 151, Mar. 27, 1931, page 340.

This paper, which was read before the Institute of Metals, Mar. 12, 1931, as it appears in the *Journal of the Institute of Metals* is accompanied by discussion. Discussion is also included in *Engineering,* Vol. 131, Mar. 20, 1931, page 383. See *Metals & Alloys,* Vol. 2, July 1931, page 126. LFM (2)

The Production and Applications of High-Nickel, Nickel-Copper Alloys and Pure Nickel in Industry. N. C. Marples. *Metal Industry.* London, Vol. 37, Nov. 21, 1930, pages 485-487, 490; *Foundry Trade Journal,* Vol. 43, Nov. 20, 1930, pages 353-354.

From paper read before the Scottish section of the Institute of Metals in Glasgow. Ni-Cu alloys were used as early as the 3rd century, B. C., while metallic Ni was not discovered until 1751. Highest mechanical properties in Ni-Cu alloys were obtained from alloys whose Ni content was between 60 and 80%. This group of alloys have an outstanding representative in Monel metal. Pure Ni is used as an additional element in ferrous and non-ferrous alloys; as anodes for plating; and as malleable Ni in form of rod, sheet, strip, wire, tubing, etc. Monel metal properties are: ultimate tensile strength, 40-45 tons/in.^{2}; yield point, 35-38 tons/in.^{2}; proportionality limit, 28-30 tons/in^2; elongation, 20% on $4\sqrt{\text{area}}$. Additional properties discussed were: corrosion resistance, strength at high temperatures and various applications. VSP (2)

A Study of Tin-Base Bearing Metals. II. G. B. Karelitz & O. W. Ellis. *Metal Industry,* London, Vol. 36, Feb. 14, 1930, pages 197-201.

Condensed from paper read at the annual meeting of the American Society of Mechanical Engineers at New York, Dec. 2 to 6, 1929. Discusses the mechanism of wiping of babbitt linings and certain phenomena observed during the casting of tin-base alloys. See also *Metals & Alloys,* Vol. 2, Oct. 1931, page 205. VSP (2)

A New Aluminium Alloy. *Automobile Engineer,* Vol. 21, Sept. 1931, page 356.

The Birmingham Aluminium Casting, Ltd., has developed an alloy unaffected by ordinary atmospheric conditions of a specific gravity of 2.68. It forms a corrosion-resisting film and the claim is made that it is particularly useful for marine purposes. Castings have a yield point of 5-7 tons/in.^{2} and an ultimate strength of 14-15 for chill cast bars; 9-10 tons/in.^{2} for sand cast bars. Brinell hardness is 54-58. It is exceedingly suitable for extruding and rolling with higher values as for casting. Ha (2)

Gray Iron Possesses Valuable Engineering Properties. *Foundry,* Vol. 59, May 1, 1931, pages 58-61, July 1, 1931, pages 61-63.

Sixteenth article of a series. Gray iron resists many corrosive fluids used in manufacturing plants. Nature of fluid, concentration, temperature pressure and pressure of impurities all have an influence on the corrosive action. Oils with high S content are corrosive. Strong acid lowers corrosive attack. Wear resistance depends on various factors. Abrasives promote heavy wear. Under certain conditions, gray iron castings may contain chilled edges due to fins, improper analysis and other causes. Combined and total C and P affect machinability of gray iron. Alloys which promote graphitization, such as Ni, Al, etc., increase machinability while those that inhibit disintegration of carbides, such as Cr, diminish it. Good cupola operation is beneficial in obtaining uniformity in machinability. Poor tool material, improper heat treatment, incorrect grinding, poor setup, etc., are also sources of trouble. VSP (3)

German Special Steels. Ernest Pohl. *Engineering Progress.* Vol. 12, Jan. 1931, pages 1-6.

Physical properties, analyses and treatment of the following steels are given: open-air corrosion-resisting and stainless steels, structural steels, steel for boilers and chemical apparatus, steel for machine parts, for anchor chains, magnetic steels and tool steels. Ha (3)

One Per Cent Copper Steel has Desirable Physical Properties. H. B. Kinnear. *Iron Age,* Vol. 128, Sept. 24, 1931, pages 820-824.

Conclusion of an article appearing in *Iron Age,* Sept. 10, 1931. "Jump" in Cu steels first appears with Cu content of 0.50% and increases up to 0.90%, after which it decreases until it disappears at 5% Cu. Cu seems to produce the same hardening effect when in combination with such alloys as Mo, Cr, V and Zr. Cu steels may be forged. In conclusion: (1) Cu lowers the A_3 point; (2) Cu in steel or gray iron produces fine grained structures; (3) no evidence of red shortness in shafting forged from sand cast ingots of 1% Cu steel low in S is seen. Includes bibliography. VSP (3)

Manufacture, Properties and Uses of 18-8 Chromium-Nickel Wire. W. H. Wills & J. K. Findley (Ludlum Steel Co.). *American Society for Steel Treating, Preprint* No. 27, 1931, 16 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The authors illustrate their description of the process of drawing this material into wire with 6 micrographs and cite 3 references. The properties and uses of the wire are reported and discussed. WLC (3)

Forming and Fabrication of Stainless Steels. Edward Houdremont. *Metal Stampings,* Vol. 4, Feb. 1931, pages 117-118.

Abstract of an article translated from *Stahl und Eisen.* See *Metals & Alloys,* Vol. 2, Mar. 1931, page 63. JN (3)

High Grade Chromium-Nickel Steel Castings (Ueber hochwertigen Chrom-Nickel Stahlguss). Viktor Zsak. *Giesserei,* Vol. 16, Mar. 1, 1929, pages 193-205.

Paper reporting an extensive series of experiments on Ni-Cr steel castings containing Ni 3.00-3.75, Cr 0.55-0.95%; data are presented on the mechanical properties and microstructure of castings in various conditions. The results of the experiments recorded lead to the conclusion that in steels of the composition under consideration very good mechanical properties may be obtained by accurate control of the conditions of casting, combined with a simple annealing treatment. It is preferable, however, to use the material in the more thoroughly heat-treated state, i.e., in the hardened and tempered condition, since such treatment further enhances the mechanical properties of the original material and eliminated variations in composition and structure which may exist in the untreated steel. (3)

Iron-Nickel-Chromium System. Walter A. Dean. *Heat Treating & Forging,* Vol 16, Oct. 1930, pages 1285-1288, 1291.

From thesis submitted to Rensselaer Polytechnic Institute. See *Metals & Alloys,* Vol. 1, Dec. 1930, page 900. MS (3)

Classifies Gray Iron Mixtures. *Foundry,* Vol. 59, May 1, 1931, pages 61-63.

Abstracted from *Bulletin No. 3 of Gray Iron Institute.* Gives additional results obtained from a series of test bars. VSP (3)

Copper Steels, their Corrosion Resistance (Les aciers au cuivre, leur resistance a la corrosion). *Cuivre et Laiton,* Vol. 4, June 30, 1931, pages 275-285.

A comprehensive review of sheets, tubes and other products of steels containing from 0.03 to 0.3% Cu. The test results of American and German laboratories are cited showing that the average corrosion loss in air of ordinary steel was about 2 to 3 times more per ft. exposed than with Cu steel. The losses by attack from various acids (organic and inorganic) amounted to 23-70% of ordinary steel. A special steel of 0.3-0.5% Cu and 0.4-0.6% Cr had the following properties: tensile strength, 54-60 kg./mm.^{2}, elastic limit 36-41 kg./mm.^{2}, elongation 22-28%. A list of the very extensive fields of application is added. Ha (3)

High Strength Cast Iron Keeps Pace with the Times. *Machine Design,* Vol. 3, Feb. 1931, pages 49-50.

The Gunite Corporation, Rockford, Ill., manufactures an air furnace pearlitic iron of greater fineness and more uniform distribution of graphite carbon particles. The result is higher strength so that much can be gained in lighter sections. A few characteristic curves are given. Ha (3)

Alloy Structural Steel. *Vancoram Review,* Vol. 2, Oct. 1931, pages 123-126.

The analysis of a few alloyed V steels are given which are to take the place of the normal soft C steel for structural purposes. These steels contain Mn, Si, Cr and V and show a remarkably high yield ratio, which varies, for the different kinds, between 0.66% and 0.78%; while in soft C steel it is about 0.6%. A few remarks on cold working for fabrication and the attending changes are added. Ha (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosion Testing. *Metallurgist*, Jan. 1931, pages 2-3.
The present large number of accelerated corrosion tests, based on various fundamental phases of the corrosion reaction and also based on exposure to various media indicate that the time is not yet ripe for a standardized corrosion test. Until our knowledge of the fundamental "corrosion resistance," if such exists, of a material is sufficiently accurate so that different observers will not get conflicting results, the introduction of "standard" corrosion tests is to be deprecated. VVK (4)

The Action of Bacteria in the Tuberculation of Water Mains. H. G. Reddick & S. E. Linderman (U. S. Pipe and Foundry Co.). *Water Works Engineering*, Vol. 84, Nov. 18, 1931, pages 1611-1612, 1622-1624.
A tubercule is a growth of a limpet-like structure on the surface of iron. These incrustations consist of a cone-like structure which grows by the addition of concentric layers. The central portion is black and soft when fresh and contains iron sulphide. The middle layers are composed of ferric oxide, while the outside layers are composed of ferric oxide interspersed with hard black layers of magnetic oxide of iron. Several analyses of tuberculation specimens are given and all show a close analogy to typical bog ore analyses. They also are magnetic, contain water of hydration and are nodular, as are bog ores and limonites. Since bog ores and limonites are results of bacterial deposition, tuberculation is thought to be a result of bacteria. Suitable cultures were made up, bacteria were cultivated and their ability to collect iron was demonstrated. CBJ (4)

Pitting in Worm Gears. H. Walker. *Automobile Engineer*, Vol. 21, June 1931, pages 223-224.
An investigation into the cause of pitting which occurs almost invariably on the leaving side of the tooth. This investigation led to the probable explanation that certain spots on the worm-thread surfaces come into contact twice during each passage of the thread across a wheel tooth and that during the first contacts, the worm-thread surface may be amply lubricated while during the second contact it is quite possible that sufficient lubricant may not be present to give an oil film because the lubricant may have been squeezed from the surface during the first contact. The facts bear out this explanation, because the pitting takes place at the part of the wheel of the second contact. Ha (4)

Corrosion Tests on Pure Aluminum and its Alloys (Essais sur la corrosion de l'aluminium pur et de ses alliages). A. von Zeerleder & E. Zurbruegg. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 599-610. 21 figures.
Tests by the Mylius rise-of-temperature method, by the gas evolution method, by loss of weight in various acids and solutions, by tensile tests after exposure to salt spray, and by measurement of electric potential are tabulated and plotted, for Al of varying purity, for the alloy with 1½% Mn, and for several strong, heat-treated alloys as well as some casting alloys. No conclusions are drawn as to the ability of the different alloys to withstand different corrosive conditions in actual service, or as to the correlation between the laboratory tests and service results. The data are given to illustrate the various type of corrosion testing methods. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 208. HWG (4)

Influence of Variations in Heat-Treatment and Ageing of Duralumin. A. von Zeerleder (Eidgenössische Technische Hochschule, Zürich). *Institute of Metals, Advance Copy* No. 585, Sept. 1931, 13 pages.
Laboratory corrosion tests indicated that Duralumin could be quenched in either water or oil at 50° C. and aged at this temperature without decreasing its corrosion resistance. After aging at 145° C., however, the corrosion resistance is very low. Sheets quenched in warm water or oil do not warp as much as those quenched in cold water. The difference in corrosion resistance of Duralumin treated in various manners can be explained by differences in potential produced. Bibliography of 6 references. JLG (4)

Common Method for Testing Corrosion. Harry F. Perkins (St. Louis Surfacer & Paint Co.) *Oil & Gas Journal*, Vol. 29, Sept. 18, 1930, pages 39, 74.
The author gives the following directions for testing corrosion each item of which he discusses in detail: Select materials that can be conveniently manufactured and that can be used conveniently in the service under consideration. The specific gravity of the metal under test must be known. A check sample of steel or other metal commonly used should always be employed. (1) Clean surface of all scale and foreign material. (2) Measure all exposed surface accurately in square centimeters. (3) Weigh to fourth decimal point in grams. (4) Suspend or support in corrosive medium at a point where the corrosive action will be as near as possible to that of actual service. (5) Insulate samples electrically and maintain a clear spacing of 1 in. (6) Remove samples periodically (once a mo.) wash off mud, oil and loosely adhering corrosion products using as little force as possible. Dry quickly. (7) When dry weigh carefully and examine for pits and scale. (8) Replace in test. (9) Final weighing should be made after every trace of corrosion products has been removed. Data in the form of a chart is given on several metals exposed to oil vapors and moisture. VVK (4)

The Use of Phosphate in Boiler Water Conditioning. F. J. Matthews. *World Power*, Vol. 16, Oct. 1931, pages 307-312.
Discusses the treatment of boiler water to prevent corrosion and scale formation. The general conclusion is that in order to prevent adherent scale formation on boiler heating surfaces, it is only necessary to adjust the ratio of the requisite acidic ions so that throughout the whole period of evaporation the solubility products of substances of positive temperature coefficients will always be reached before the solubility products of substances with negative temperature coefficients. Data shows that phosphate conditioning is quite satisfactory for a boiler operating as high as 1300 lbs. pressure. WAT (4)

Chrome Iron Indispensable in Nitric-Acid Plant. E. St. P. Bellinger (Hercules Powder Co.). *Chemical & Metallurgical Engineering,* Vol. 37, Nov. 1930, pages 691-692.

Addition of Cr to a low-C steel increases the resistance to corrosion by HNO_3, the resistance increases very rapidly between 13-18% Cr, beyond 18%, the effect of Cr is slight. More than 0.12% C or 1% Si lessens the resistance to corrosion. Small amount of Si is essential, however. Heat treatment is an important factor in determining rate of corrosion. Prolonged annealing at 1450° F. is generally considered the best heat treatment. Metal becomes hard and brittle, accompanied by reduced corrosion resistance when heated for long periods at 600°-800° F. or to temperatures above 1700° F. followed by air cooling. Re-annealing restores the original qualities. In general, cast material has higher rate of corrosion than worked. Subjection of properly annealed and worked material to heat, shock and strain does not appreciably increase rate of corrosion. Metal can be worked safely at 1000°-1400° F. Presents results of tests in a table and by means of curves. MS (4)

The Constitution of Scale. L. B. Pfeil. *Engineer,* Vol. 151, May 15, 1931, page 536.

Abstract of paper read before the Iron & Steel Institute, May 7-8, 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 248. LFM (4)

Cadmium and Zinc Plating as Rust Preventives. *Brass World,* Vol. 27, Aug., 1931, pages 171-175.

An article based on a paper given before the Electroplaters' & Depositors Technical Society in London. Comparison is made of deposits of the 2 metals as to corrosion resistance, acid resistance, and color. Strong acids attack Zn more readily than Cd while after removing the coating corrosion of the underlying ferrous metal appears to be slower with Cd than with Zn. Alkalies attack Zn more readily, but also discolor Cd. WHB (4)

Pipe Line Corrosion and Soil Conductivity. *Engineering News Record,* Vol. 107, July 23, 1931, page 135.

Observations made by the Bureau of Standards, of corrosion, electric current and soil conditions on 9 pipe lines, led to the conclusion of a definite correlation between pipe corrosion and soil resistivity. Where soil conductivity is high, corrosion occurs. A method of measuring soil resistivity with 2 oak rods tipped with iron, one carrying a small flash light battery and the other, a milliammeter with 100 milliampere scale. The rods are pushed down into the ground about 8 ins. apart. The soil resistivity was measured along pipe lines and all stretches in which the soil was abnormally conductive were found to be regions of corrosion trouble and, generally, of current departure. The soil resistivity at such places was usually below 500 or 600 ohms/cm.^{3} With higher resistivities, no marked corrosion was found. Ha (4)

Rust Preventive Agents. *Chemical Age,* London, Vol. 23, Metallurgical Section, Nov. 1, 1930, page 28.

2 new rust preventive agents have been reported by the German Mannesmann Tube Works. Herolith is a synthetic resin and is applied by brushing, prior to which scale is removed by pickling. Tubes coated with it have successfully withstood thorough mechanical and chemical tests; the former comprises tests for resistance to shock, scratching and conveyance by train or motor. 35 corrosive agents were used in the chemical tests, only 3 of which (hydrofluoric acid, caustic potash solution and caustic soda solution) had any effect on the tubes. Dry heat up to 220° C. and intermittent temperatures up to 300° C. do not injure the coating. Tornesit is a rubber product similar in appearance to cellulose. It can be brushed on the part to be protected without preheating being necessary and dries in 3 minutes. It hardens to such an extent after a few hours that even heavy hammer blows do not damage the coating. In contrast to herolith, tornesit is resistant to alkalies and is only attacked by hydrogen sulphide, water, benzol, acetone and aniline. It can be employed as a protective coating for iron and steel, wood, brickwork and concrete. No original data is given. VVK (4)

Copper Steel and the Mechanism of its Resistance to Corrosion (L 'acier au cuivre et le mécanisme de sa résistance à la corrosion). *Cuivre et Laiton,* Vol. 4, Nov. 15, 1931, pages 495-498.

As the theory developed by Carius (*Zeitschrift für Metallkunde,* Oct., 1930, Nov., 1930, see *Metals & Alloys,* Vol. 2, July, 1931, page 127) on the corrosion of copper steels does not furnish entirely satisfactory explanations, the phenomenon is discussed here with some modifications and the discrepancies with facts are noted. The action of atmosphere first forms a layer of rust under which, after some time, a layer of copper oxide appears; this layer is impermeable and stops the further progress of oxidation of the steel. The copper oxide is the result of a thin film of copper which has formed on the steel. A section through the steel thus reveals a thin layer of copper on the steel on which a layer of copper oxide is formed. Similar conditions occur in the attack by distilled water. Salt solutions have a more complex effect. A section through the steel shows first a thin layer of powdery copper on the steel, then a film of green ferrous hydroxide, on which a layer of ferro-ferric hydroxide is found and, finally, the outer layer formed of a red-brown ferric hydroxide. The formation of these different layers is explained by the high oxidation potential in saline solutions. In acid solutions, copper steel is particularly resistant because the copper layer on the steel is especially compact and dense here and offers a very good protection against further corrosion. Ha (4)

Protection of Iron Containers Against Acids by Lead Lining by the Oxy-Acetylene Flame (Säureschutz für Eisenbehälter durch Verbleiung mittels Azetylen-Sauerstoff-Flamme). *Schmelzschweissung,* Vol. 10, Aug. 1931, pages 202-203.

In order to obtain a firm adhesion of the Pb lining to the walls of the tank, these walls are first coated with a solder of an alloy of Sn and Pb in equal parts and which combines well with the tank material and the Pb. The method is described and illustrated. Ha (4)

STRUCTURE OF METALS AND ALLOYS (5)

Laws Governing the Segregation of Minute Quantities of Matter in the Case of Solid Solution Formation (Ueber die Gesetzmässigkeiten bei der Abscheidung kleinster Substanzmengen unter Mischkristallbildung). R. Mumbrauer (Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem). *Zeitschrift für physikalische Chemie,* Sect. A, Vol. 156, Sept. 1931, pages 113-134.

The experiments aim at a clear conception of the mechanism dominating the distribution of minute quantities of matter between a solid and liquid phase, in the case that solid solutions are formed. The way of distribution of the microscopic component within the system of solid solutions in relation to the working conditions is furthermore systematically studied. A hypothesis concerning the mechanism of segregation is evolved from the observations made. EF (5)

Metallography and Macrography (5a)

Alloys of Iron, Manganese and Carbon. Part I. Preparation of Alloys. Francis M. Walters, Jr., *Mining & Metallurgical Investigations Bulletin* 101, 1931, pages 1-13.

Because of the importance of Mn as an alloying element, a systematic study of this tenary system was undertaken. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. Ha (5a)

Alloys of Iron, Manganese and Carbon. Part II. Thermal Analysis of the Binary Alloys. Francis M. Walters, Jr. & Cyrill Wells. *Mining & Metallurgical Investigations Bulletin 101,* 1931, pages 14-22.

The thermal analysis was made on alloys of high purity of Fe-Mn with from 0 to 60% Mn in a modified gradient furnace of Rosenhain. The results agree in general with those of previous investigators. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. Ha (5a)

Alloys of Iron-Manganese and Carbon. Part IV. A Dilatometric Study of Iron-Manganese Binary Alloys. F. M. Walters, Jr. & M. Gensamer. *Mining & Metallurgical Investigations Bulletin* 101, 1931, pages 32-45.

In these studies, a dilatometer was used in which the specimen can be tested at temperatures from — 200° to 1000° C. in a vacuum or an inert gas. The indications of phase changes observed by thermal analysis have been confirmed and extended. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. Ha (5a)

Magnetic Properties Versus Allotropic Transformations of Iron Alloys. T. D. Yensen & N. A. Ziegler (Westinghouse Electric & Mfg. Co.) *American Institute of Mining & Metallurgical Engineers, Technical Publications* No. 427, Sept. 1931, 7 pages.

Elements that increase γ field adversely affect the magnetic properties of Fe, while, in general, those that tend to close the γ loop have a beneficial effect. The latter group of elements tends to distort the Fe lattice less than elements of the former group. The elements that increase the permeability of Fe do so because they precipitate harmful elements from solution. 15 references. JLG (5a)

The Surface Energy of Iron Carbide. Yap, Chu-Phay. *American Society for Steel Treating, Pre-print* No. 10, 1931, 24 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. 13 references to the literature are cited. The author presents a theory that the hardness of steel is accounted for by the surface energy of iron carbide. The particle size of Fe_3C dispersed in martensite is of the order of 3 to 4 times 10^{-7} cm. in radius. A physico-chemical picture of the role of surface energy in the hardening of alloys is presented. WLC (5a)

Lead-Thallium Alloys. R. R. Rogers. *Mining & Metallurgy,* Vol. 12, Feb. 1931, pages 96-97.

The existence of a compound, $PbTl_2$ has been confirmed. Solid solutions of $PbTl_2$ in lead exist between O and 67% Tl. Pb-Tl alloys possess good corrosion resistance and compressive strength, particularly with additions of Sn, Bi and Ba. Tl in lead has practically no effect on the passivity of the anode from 0.5 to 2.0%, but beyond this concentration, a decided effect in the lowering of the Pb in the cathode Zn takes place. Ha (5a)

Deep Etch is Valuable Tool to Brass Foundrymen. R. W. Parsons. *Foundry,* Vol. 59, June 1, 1931, pages 51-53.

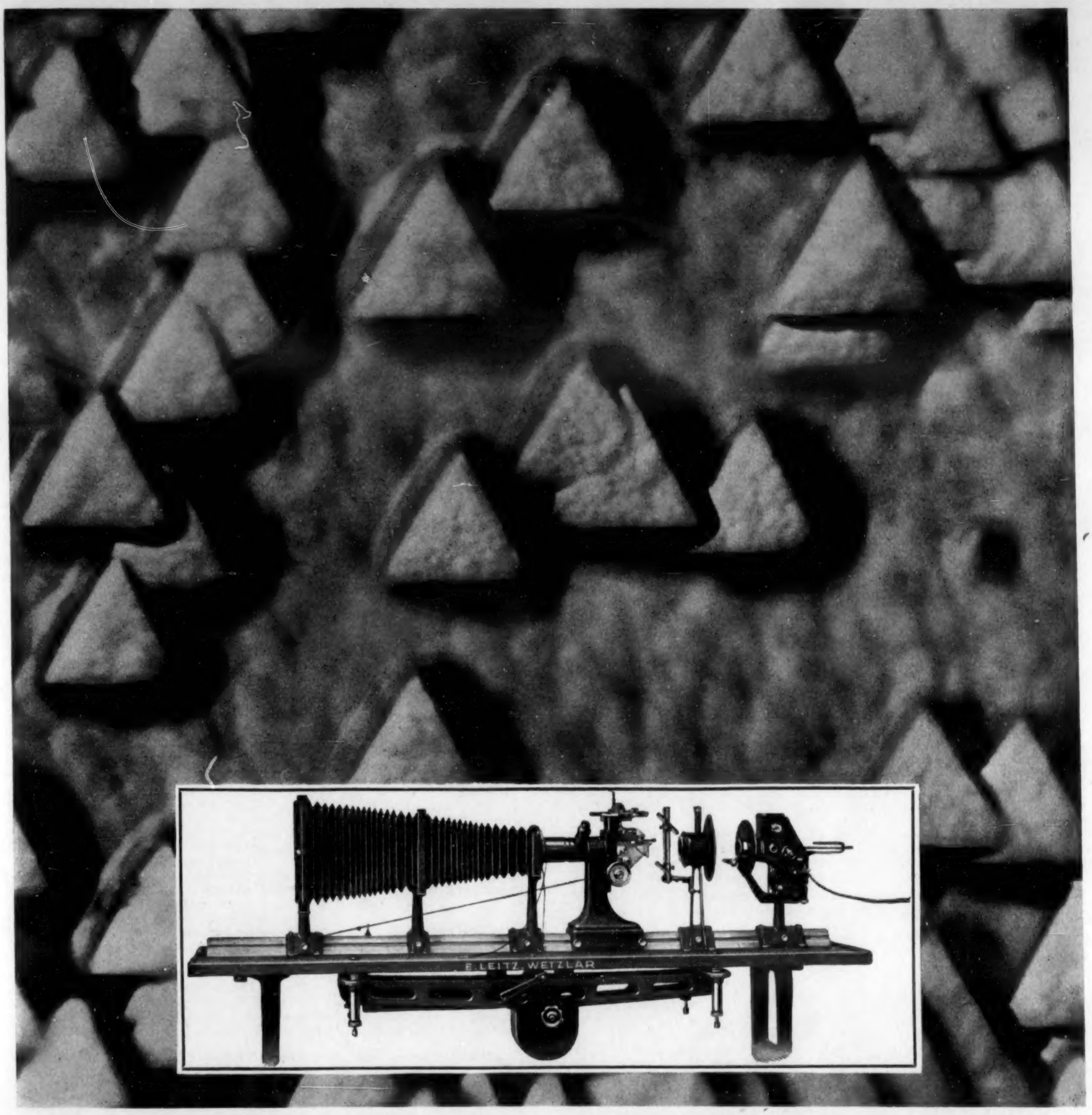
Deep etching of brass is accomplished by subjecting the specimen to the action of concentrated commercial nitric acid for a period of 7-8 min. Although this method is very valuable in detecting defects, limitations must be placed on the application of the test to red brass in general. It is explained that it is practically impossible to draw any conclusions with regard to metal conditions from etched sections of dissimilar castings because gating plays a very important part in determining the quality of the casting. The results of the etch test and the method of gating should be studied for similar castings to find improvements for the quality of the castings. Several examples illustrate the method. Ha (5a)

The Microscope for Production Control in the Small Plant. G. E. Shoemaker. *Iron Age,* Vol. 128, Oct. 29, 1931, pages 1100-1104.

The author explains and describes the advantages and possibilities of laboratory control of production by showing micrographs and macrographs of good and of defective metal specimens. He gives a layout of a little laboratory for simple metallurgical and chemical tests. Ha (5a)

Illumination of Metallurgical Specimens. Conrad Beck. *Journal Royal Microscopical Society,* Vol. 50, Sept. 1930, pages 319-322.

For vertical illumination, the prism reflector is satisfactory with low powers, but with high powers the loss of aperture, and hence of resolution, is considerable. The correct use of the transparent reflector is described, the essentials being centration of the light, complete illumination of the objective, and focussing of the light on the specimen. The question of glare is discussed and Wrighton's method for its elimination is described. It is suggested that ultraviolet illumination may not be of much value in metallurgy, as the reflective power of metals is less for ultra-violet than for visible light, and trouble due to glare is therefore accentuated. Ha (5a)



The Basic Structure of "X-ITE" - 7200X-Nickel-Chromium Alloy - Conical oblique illumination-Magnetic arc lamp - Apo. Oil Im. 2 mm, N. A. 1.32, - Per. Ocular 8X Wr. "B" filter - Wr. "M" plate - 1. min. exposure - CHG method sample preparation. Taken with LEITZ "MM."

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The Brass Foundry in America; the Deep Etching Test for Brass (La fonderie de Laiton, en Amerique. L'essai d'attaque profonde du laiton). *Cuivre et Laiton*, Vol. 4, Sept. 15, 1931, pages 406-411.

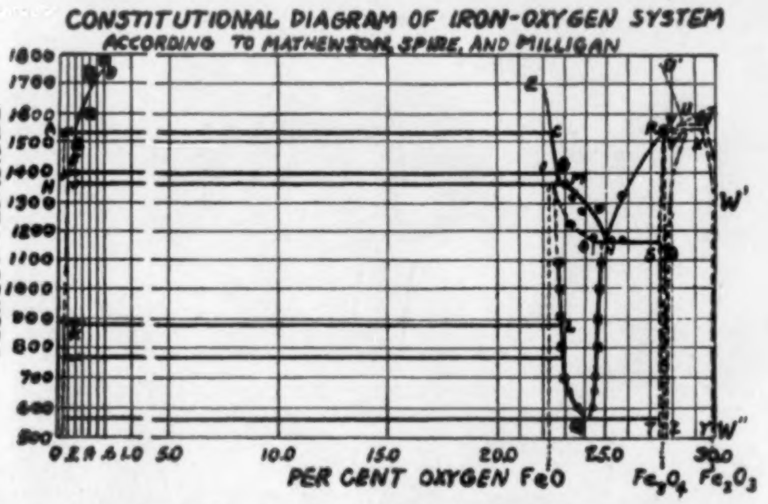
The deep etching test has been very well developed for ferrous materials, but not for non-ferrous metals. The author reviews American methods for utilizing this method of deep etching on the surface for macrographic examination and advises their use for the supervision of the furnaces. Several examples are illustrated. Ha (5a)

A Study of the Constitution of the Iron-Tin Alloys. C. A. Edwards & A. Preece. *Engineer*, Vol. 152, Oct. 2, 1931, page 347; *Iron & Coal Trades Review*, Vol. 123, Oct. 2, 1931, page 495.

Abstract of a paper read before the Iron & Steel Institute, Swansea, Sept. 1931. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 302. LFM+Ha (5a)

Evolution of the Iron-Oxygen Constitutional Diagram. C. H. Mathewson, E. Spire & W. E. Milligan (Yale University). *Transactions American Society for Steel Treating*, Vol. 19, Nov. 1931, pages 66-88; *Metal Progress*, Vol. 19, Apr. 1931, page 83.

Doctor's thesis of E. Spire. 29 references to the literature. 12 micrographs show structures described. The authors discuss previous reports on the iron-oxygen diagram. Considerable consideration is given to the equilibrium between oxide phase and iron containing oxide in the liquid state



and cooled. Oxygen appears to widen the range of stability of the γ phase in iron, in which it is more soluble. The region of the diagram representing equilibrium between ferrous and ferric oxides has been studied by thermal and microscopic methods. A diagram is constructed in the light of the work of previous investigators and the findings of the authors. The oxide particles found in iron may be either ferrous or combined ferrous-ferric according to the thermal treatment. WLC (5a)

Microstructure of Pearlite. H. E. Publow & C. Heath (Michigan State College). *Metals & Alloys*, Vol. 2, Sept, 1931, pages 155-157.

The authors discuss, with 12 micrographs illustrating their study, the mechanism of the recrystallization of austenite as it cools through the critical ranges. The micros are of low C steel, to which the discussion applies. WLC. (5a)

Diffusion in Metals (Diffusion in Metallen). G. von Hevesy & W. Seith. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.-Sept. 1931, pages 528-531.

The diffusion of a metal in another solid metal is, in most cases, a practically one-sided phenomenon. The diffusion velocity of Au in Pb is a very fast one, while that of Pb into Au is very slow. With increasing similarity of the 2 constituents of an alloy, for instance for the transition Au-Pb, Ag-Pb, Bi-Pb, Tl-Pb, Pb-Pb, the one-sidedness of the phenomenon disappears gradually. At the same time, the activation heat of the faster diffusing constituent is increased. Measurements of diffusion permit the determination of even very small solubilities of one metal in another, e. g., the solubility or Ag in Pb was found at 285° C. to be 0.13 atomic %. 7 references. Ha (5a)

Transformations in Light Aluminum Alloys in Accordance with their Structure. G. A. Kaschtchenko. *Transactions of the Second Conference of Non-Ferrous Metals of U. S. S. R.*, 1927, pages 326-358.

Heat-treated alloys containing 1.5, 3.0, 5.0, 7.0 and 12% Cu and also 1.2, 2.5, 5.0, 10 and 20% Mg have been examined. In order to attain uniformity, all the specimens were etched simultaneously. It was shown that the aging of light Al alloys must be ascribed to the separation of $CuAl_2$ from the solid solutions. The addition of Mg causes an increase in hardness due to a solid solution with Al, but has no influence on the aging process as a whole. Although it assists the disintegration of the solid solution, permitting the separation of $CuAl_2$ at a lower temperature, magnesium silicide has no influence on the aging process, being present in negligible quantities, and the effect ascribed to it is due to the separation of $CuAl_2$ at a lower temperature owing to the presence of Mg. (5a)

Decomposition Structures of Copper-Zinc Alloys and Copper-Aluminum Alloys. Robert F. Mehl & C. T. Marzke. *Rolling Mill Journal*, Vol. 5, Mar. 1931, page 219.

Abstract of a paper presented at the New York Meeting of the American Institute of Mining and Metallurgical Engineers, week of Feb. 16, 1931. See *Metals & Alloys*, Vol. 2, June, 1931, page 111. JN (5a)

Arrangement of Micro-Crystals in Rolled Foils of Tungsten and Molybdenum. *Proceedings World Engineering Congress, Tokyo*, 1929, published 1931, Vol. 36, *Mining & Metallurgy*, Part 4, pages 179-182.

One (100) plane orients itself parallel to the direction of rolling, within 10°. HWG (5a)

Metallographers' Handbook of Etching. Torkel Berglund. Translated from the Swedish by W. H. Dearden. Isaac Pitman & Sons, London & New York, 1931. Cloth, 5½ x 8½ inches, 183 pages including bibliography and index. Price $3.75.

This book, sponsored by the Swedish Society of Metallographers, will be a boon to all practitioners of the art, most of whom it is safe to say have been privately collecting lists of etching reagents. The compilation of ferrous and non-ferrous etchants is much more extensive than those heretofore published by such agencies as the American Society for Testing Materials, the American Society for Steel Treating, and the Verein Deutscher Eisenhüttenleute. Moreover, the book is more than a mere handbook. The originality of the treatment of the technique and rationale of metallographic etching together with numerous notes on experience with various etchants justify classing the work as a real contribution to metallographic knowledge. The book is clear and easy to read. The scarcity of illustrations may perhaps detract from its usefulness for the beginner, but the well versed metallographer will hardly regret this lack. There is a good index.

Under the heading Chemistry of Etching a very lucid explanation, greatly aided by the ionic notation in vogue in electrochemical texts, is given of the chemical action of the various groups of etchants. The technique of etching electrolytically, by heat tinting, and in vacuum is described as well as the less well known method of etching with gelatine films in which etching media have been impregnated. This is covered in considerable detail although the gelatine method of detecting pin holes in tin plate is omitted. The subject of revealing fine cracks is also embraced, although it is not dealt with very extensively. Etching by cathodic sputtering is briefly mentioned.

After a general discussion of macro-etching, a detailed account is given of the composition and action of the various copper bearing agents, including Fry's reagent for revealing strain lines. Among these numerous reagents only d'Huart's reagent, similar to Fry's, has apparently escaped the author's attention. Koster's results and those of his German colleagues on the relation between the N content of a steel and its response to strain line etching probably appeared too late for inclusion in the book.

For micro-etching of steel the author recommends a 4% solution of nitric acid in amyl alcohol. The alkaline reagents for carbides in plain C and alloy steel, especially high speed steel, are handled at length and adequately. The treatment of etchants for nitrides is on the other hand very brief, the newer copper bearing reagents receiving no mention. The etching of stainless steel is well covered, the indispensable precaution of repeated etching and polishing of the soft austenitic type being emphasized. There is an extremely interesting account of the etchants for sulphides in steel in which the gelatine technique has a prominent place. In dealing with the etching and identification of inclusions in steel in general, the author has relied mainly on the work of Campbell and Comstock and of Wohrman.

Non-ferrous etchants are dealt with more briefly, this section comprising only one-fifth of the book. However, the etching of Al, particularly, and Cu, and Ni and their alloys is very adequately treated, although no attempt is made to recommend solutions for special alloys. For example, one desiring to etch speculum metal (70% Cu, 30% Sn) would have to use his own judgment in selecting an etchant from among several given for Cu and its alloys. No mention is made of etching reagents for the noble metals or alloys in use as jewelry and as dental alloys.

Samuel Epstein (5a) -B-

Some Physico-Chemical Modifications of So-Called Pearlitic Iron (Sur quelques modifications physico-chemiques des fontes dites perlitiques). A. Le Thomas. *Congrés International des Mines, de la Métallurgie et de la Géologie appliquée Section de Métallurgie*, 6th session, Liege, June 1930, pages 831-852. 32 figures.

Includes discussion on this and other papers on high-strength cast iron presented at the same session. See *Metals & Alloys*, Vol. 2, Nov., 1931, page 250. HWG (5a)

Nickel-Chromium and Iron-Nickel-Chromium Alloys. *Metallurgist*, Sept. 1931, pages 134-136.

A brief résumé of the subject presenting the most recently developed constitutional diagrams. WAT (5a)

The Formation of Ferrite from Austenite. H. C. H. Carpenter & J. M. Robertson. *Iron & Steel Industry & British Foundryman*, Vol. 4, May 1931, pages 273-275.

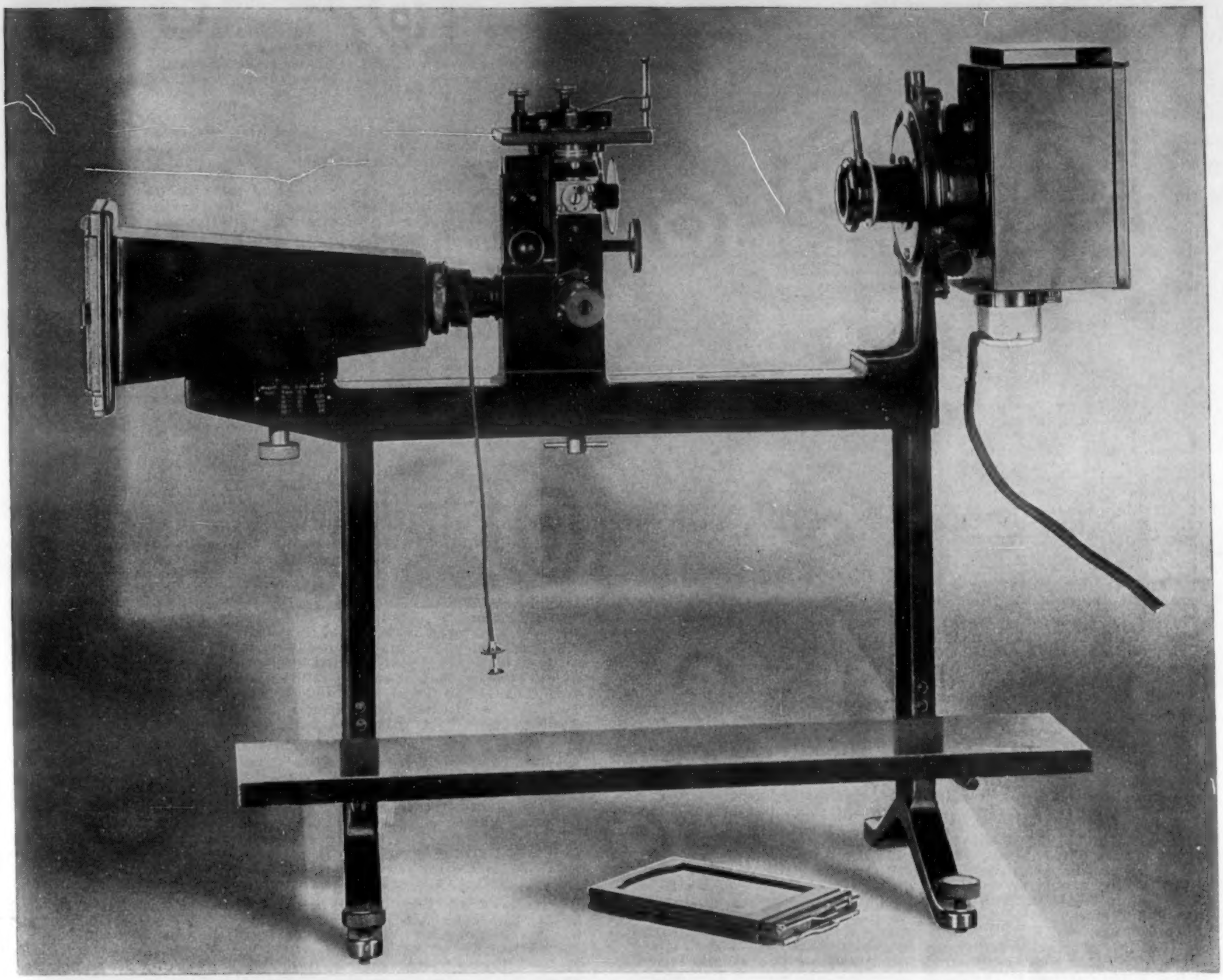
The different ferrite-pearlite structures produced from grains of austenite as affected by the C content and rate of cooling of steel were studied. A theory to explain the structural changes is advanced. See *Metals & Alloys*. Vol. 2, Nov. 1931, page 252. CHL (5a)

The Sub-Crystalline Structure of Ferrite. C. O. Bannister & W. D. Jones. *Iron & Steel Industry & British Foundryman*, Vol. 4, June 1931, pages 297-298.

Abstract from Iron & Steel Institute paper. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 250. CHL (5a)

Practical Methods for Study and Control of Cast Iron, New Metallographic Procedure for Graphite (Méthodes simples et pratiques pour l'etude de la fonte de fer et le controle de la fabrication des moulages, nouveau procédé de métallographie du graphite). L. F. C. Girardet. *Congrés International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 854-861. 16 references, 18 figures.

Treats with effect of graphite, with various methods of testing, including shear, which the author characterizes as the best mechanical test for cast iron, and with metallographic examination. He suggests study of graphite after etching with 25 cc. HCl, 100 cc. H_2O, 10 g. CrO_3, 5 grams anhydrous $NiCl_2$. This etchant is claimed to show up the size and shape of the graphite particles more clearly than the examination of an unetched surface. HWG (5a)



Recent Progress in Japan in the Field of the Science of Metals. *Proceedings World Engineering Congress,* Tokyo, 1929, published 1931, Vol. 36, *Mining & Metallurgy,* Part 4, pages 7-60. In English.

Lists and briefly comments on 182 papers by Japanese metallurgists and reproduces many equilibrium diagrams determined or re-determined by them. Honda's ideas on the hardening of steel are given special mention. HWG (5a)

Strain Etching Figures. *Metallurgist,* Feb. 1931, pages 19-21. An extended critical review of the second part of Köster's paper ("The Problem of Nitrogen in Mild Steel," *Archiv für Eisenhüttenwesen,* Apr., 1930, page 637). Flow figures or Lüder lines appear at the beginning of the plastic deformation of a slowly cooled low carbon steel. They are patterns which are formed by the roughening of the smooth surface of the steel and, in the case of a rolled material, become visible by the breaking away of the oxide layer. They are said to be due to local deformation; the deformed portions are pushed up against the undeformed regions. They are found particularly in material in the aged condition. Fry's reagent is used for bringing out these strain etching figures. Nitride layers are strongly darkened by this reagent and steels which do not age magnetically, i. e., in which nitride does not separate out, show no strain etching figures.

In plastically deformed steel containing N, from Köster's experiments, the degree in which the deformed region is made visible by Fry's reagent is proportional to the quantity of N in supersaturated solution. By further experiments, he showed that the separation of nitride is accelerated by cold deformation and the strain figures are produced by the contrast between this separation in the deformed and undeformed regions. This was confirmed by a microscopic investigation of the structure. The precipitation of nitride proceeds more quickly in the undeformed region. After heating to higher temperatures, however, strain figures are still produced and it was shown that the deformed material retains its properties, even after heating to the higher temperature, unless recrystallization takes place. The appearance of strain figures after heating to such temperatures depends on the rate of cooling. VVK (5a)

Intimate Chats on Metallography. VIII. *Nickel Cast Iron News,* Vol. 2, Aug. 1931, pages 5, 11.

The control of C contents in blast furnace and cupola is explained. The Fe-C equilibrium diagram for cast iron is discussed and a glossary of technical terms, used in connection with the metallography of Fe, are given. Ha (5a)

The Phosphide Eutectic in Cast Iron. *Metallurgist,* Jan. 1931, pages 5-6.

Phosphorus in cast iron usually makes its appearance as a ternary phosphide eutectic, known to some as "Steadite," the melting point of which is in the region of 950° C. Künkele and Bardenheuer & Künkele (*Mitteilungen aus dem Kaiser Wilhelm Institut für Eisenforschung,* Vol. 12, 1930, pages 145-146) have investigated the Fe-P system with the following conclusions. The Fe-P-C alloys may solidify as a metastable system iron-iron carbide- iron phosphide or as a stable system iron-graphite- iron phosphide. In the first case, by exceeding the solubility of the C and P in the iron, the alloys form the ternary phosphide eutectic, of which the constituents are ternary solid solution, iron carbide and iron phosphide. In the second case, a ternary eutectic is formed, involving ternary solid solution, graphite and iron phosphide. Here, however, the graphite crystallizes on the already existing graphite flakes, and for this reason seems to disappear from the eutectic. In reference to this fact, such a ternary eutectic has been termed "pseudo-binary." Gray cast irons may, nevertheless, exhibit a normal ternary phosphide eutectic containing cementite when cooling conditions have favored solidification, at first according to the stable system and later according to the metastable system. The results of thermal analysis and quenching experiments which are given confirm this view. In the second paper, it is shown that raising the Mn content from about 0.15% to about 0.7% has practically no influence on the type of phosphide eutectic formed. The usual method of etching Fe-C-P alloys, including that of heat tinting, resulted in the colors becoming frequently blurred and the presence of other elements such as Mn and Si, seemed to increase this tendency. It was found that a boiling aqueous solution containing 5 to 8% chromic acid slightly roughened the surface of iron phosphide, and that a higher contrast between this constituent and iron carbide could then be developed by heat tinting. VVK (5a)

The Chromium-Iron Equilibrium Diagram. *Metallurgist,* Sept. 1931, pages 139-140.

A brief résumé of the subject presenting a constitutional diagram. WAT (5a)

The Electrical Conductivity and the Thermal Expansion of Magnesium-Cadmium Alloys (Die elektrische Leitfähigkeit und die thermische Ausdehnung der Magnesium-Kadmium-Legierungen). G. Grube & E. Schiedt. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 194, Dec. 9, 1930, pages 190-222.

The conversions in the solid state occurring in the Mg-Cd system at temperatures below 300° C. were explained by measurements of the change of the resistivity and the length as functions of the temperature. This was done with alloys containing 20-80% (atomic) of Mg which had been carefully annealed and subsequently cooled very slowly. From the curves so obtained, the following conditions of constitution can be stated: at temperatures above 250° C., 2 series of solid solutions exist, α and β, which are separated by a gap between 28-30 atomic % of Mg; at 89° C., the α-solid solution is transformed with 25% Mg into the compound $MgCd_3$; at 250° C. and 150° C., respectively, the β-solid solutions are transformed with 50% and 75% Mg into the compounds MgCd and Mg_3Cd, respectively. These 3 compounds again form solid solutions among themselves and with the components. The gap at 28% to 33% disappears below 120° C. The form of the resistance-temperature curves and the curves of thermal expansion for the ranges 40-60 atomic % and 70-80 atomic % Mg indicate that here the conversion from compound into solid solution takes place in 2 stages. HA (5a)

Structure & X-ray Analysis (5b)

Martensite, Recent Structural Studies. A. Westgren. *Metal Progress,* Vol. 20, Aug. 1931, pages 49-53.

5 references, 17 X-ray spectrograms and 2 curves illustrate a review of the recent studies of the nature and structure of martensite. WLC (5b)

The Magic of Modern Industry; Locating Defects and Causes of Defects by Means of the Radiograph—Determining the Hardness of Metals through Crystal Orientation. Ph. Winter. *Modern Machine Shop,* Vol. 4, Oct. 1931, pages 11-14, 16, 85.

Description of X-ray outfits, illustrations of defects in materials photographed by them, and the possibility of following the processes of manufacturing by diffraction patterns. Ha (5b)

Alloys of Iron, Manganese and Carbon. Part III. An X-Ray Study of the Binary Iron-Manganese Alloys. M. Gensamer, John F. Eckel & F. M. Walters, Jr. *Mining & Metallurgical Investigations Bulletin* 101, 1931, pages 23-31.

A systematic X-ray investigation of low C Fe-Mn alloys by the Debye-Hull method confirms, in general, the work of Schmidt and of Oehman. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. Ha (5b)

Alloys of Iron, Manganese and Carbon. Part III. An X-Ray Study of the Binary Iron-Manganese Alloys. M. Gensamer, John F. Eckel & F. M. Walters, Jr. *American Society for Steel Treating,* Preprint No. 35, 1931, pages 23-45.

A systematic X-ray study of low carbon Fe-Mn alloys confirms the general work of Schmidt and Ohman. It was found that cold work favors the formation of the hexagonal closepacked phase which is also present in some alloys on quenching but is absent from slowly cooled alloys. 11 references. WLC (5b)

Radiographic Inspection with Gamma Rays. R. F. Mehl. *American Machinist,* Vol. 75, Aug. 13, 1931, pages 278-280.

The inspection of large finished pieces by X-ray is often impossible because of the cumbersome apparatus required. The Naval Research Laboratory, therefore, made some tests with radium. The γ-rays emitted from it have a much shorter wave length (about 1×10^{-10} cm.) and the time of exposure can, therefore, be reduced. The radium is either held in a small capsule or radium emanation, a gas which radium generates spontaneously, is enclosed in a glass and metal capsule. Either can be used with equal effectiveness. The method is shown on a large irregular casting where the radium could be brought to any desired place. This had not been possible with X-rays. Ha (5b)

Iron, Carbon, Nitrogen Structural Analogies Revealed by X-Rays. A. Westgren. *Metal Progress,* Vol. 20, July 1931, pages 50-54.

The author reports X-ray studies of iron-carbon-nitrogen system giving the cell characteristics and dimensions, of various phases. The effect of nitrogen is discussed. Nitrogen equilibrium diagram shown and the relation of these results to nitriding research discussed. Absorption of nitrogen in austenite is shown. WLC (5b)

Progress in the X-Raying of Iron (Fortschritt in der Röntgendurchstrahlung von Eisen). M. Widemann. *Giesserei mit Giesserei-Zeitung,* Vol. 18, July 17, 1931, pages 576-580.

The factors affecting the further progress in testing with X-rays large metal pieces, especially of iron, are discussed in detail. X-ray tubes should be developed to stand a continuous operation with considerably more than 200 KV, as are now available. The equipment of the iron-metallurgical Institute of the Technical University, Berlin, is described and the methods usually applied are described. Exposing times for cast iron in milli-ampere seconds as a function of the thickness of the iron are determined and also as a function of the voltage. A few formulas are developed for calculating the time required for a given thickness of material and blackening effect of the film. Ha (5b)

X-Ray Investigation of Lattice Disturbances in Light Metals (Röntgenographische Untersuchungen von Gitterstörungen in Leichtmetallen). J. Hengstenberg & H. Mark. *Zeitschrift für Elektrochemie,* Vol. 37, Aug.-Sept. 1931, pages 524-528.

The object was to find whether the great increase in strength of duralumin and electron metal after refining could be proved by measuring the changes of the position of the atoms. It is assumed that a certain number of atoms are shifted somewhat from their normal position by deformation of the material. They are therefore not in phase with the other atoms of the lattice and reduce the intensity of the reflection of an X-ray; the greater the shift from the normal position, the greater is the reduction in intensity of reflection. This reduction in intensity could be verified in the tests. 6 references. Ha (5b)

Radiographic Inspection of Materials. H. R. Isenburger. *Mechanical Engineering,* Vol. 53, Oct. 1931, pages 729-735.

The relative value and application of X-rays and γ-rays for the inspection of metals are discussed. The X-rays are used for industrial purposes. The equipment is described and the various defects of castings and welds are demonstrated and explained by means of photographs. For very heavy material of more than 3 ins. thickness, γ-rays should be used because they are more penetrating. They also give finer details in thinner materials. The operating cost with X-rays amounts to from $3.00 to $5.00/hr. depending on the way in which the material is written off. Radiographic inspection costs about the same when the radio-active material is rented. Ha (5b)

Crystal Structure of the β-phase of Aluminum-Bronze. Kchija Oninata. *Nature,* Vol. 126, Nov. 22, 1930, page 809.

A fine rod of 12.5% alloy measured at 650° C. showed that the β-phase has a body centered cubic super-lattice with the parameter equal to 5.887 A.U. A sample heated to 850° C. and quenched in H_2O showed a hexagonal lattice for the β'-phase with parameters a=11.13, c=6.342 and c/a=0.5698 with the parameter for the β-phase equal to 5.835 A. U. (5b)

X-Ray Analysis of the System Gold-Antimony and Silver-Tin (Röntgenanalyse der Systeme Gold-Antimon und Silber-Zinn). O. Nial, A. Almin & A. Westgren (University of Stockholm. *Zeitschrift für physikalische Chemie,* Sect. B, Vol. 14, Sept. 1931, pages 81-90.

In regard to the Au-Sb system, the former thermo-analytical establishments of Vogel (*Zeitschrift für anorganische Chemie,* Vol. 50, July 1906, pages 145-157) and the X-ray determinations of Ofteda! (*Zeitschrift für physikalische Chemie,* Vol. 135, Aug. 1928, pages 291-299) could be fully confirmed and yielded only one intermediate phase $AuSb_2$ which shows the same atomic arrangement as pyrite. The length of the unit cell amounts to 6.647 ± 0.005 A.U. The X-ray analysis of the Ag-Sn system is in accordance with A. J. Murphy's layout (*Journal Institute of Metals,* Vol. 35, 1926, page 107) and revealed a far reaching structural identity with the Ag-Sb alloys. The Ag-Sb system exhibits a phenomenon already met with in the Ag-Sb and Fe-N alloys: 2 phases ϵ and ϵ', the latter representing only a "little deformed type' of the first crystallographic structure. The authors found that the solubility of Sn in Ag amounts to 11.4 atomic per cent at 400° C. The parameter of the face-centered cubic lattice is increased by rising additions of Sn from 4.077 A.U. to 4.125 A.U. At 400° C., the homogeneity range of the ϵ-phase covers 13.3-19.7 atomic per cent Sn and 24-25.5 atomic per cent Sn for the ϵ' phase. EF (5b)

X-Ray Investigation of Certain Nickel-Steels of Low Thermal Expansion. G. Phragmen. *Iron & Coal Trades Review,* Vol. 123, July 10, 1931, pages 40-41.

The apparatus and test method are described. See *Metals & Alloys,* Vol. 2, Nov., 1931, page 254. Ha (5b)

On a Gallium-Zinc-Spinel (Über einen Gallium-Zinkspinell). F. Buschendorf (University of Göttingen). *Zeitschrift für physikalische Chemie,* Sect. B, Vol. 14, Oct. 1931, pages 297-303.

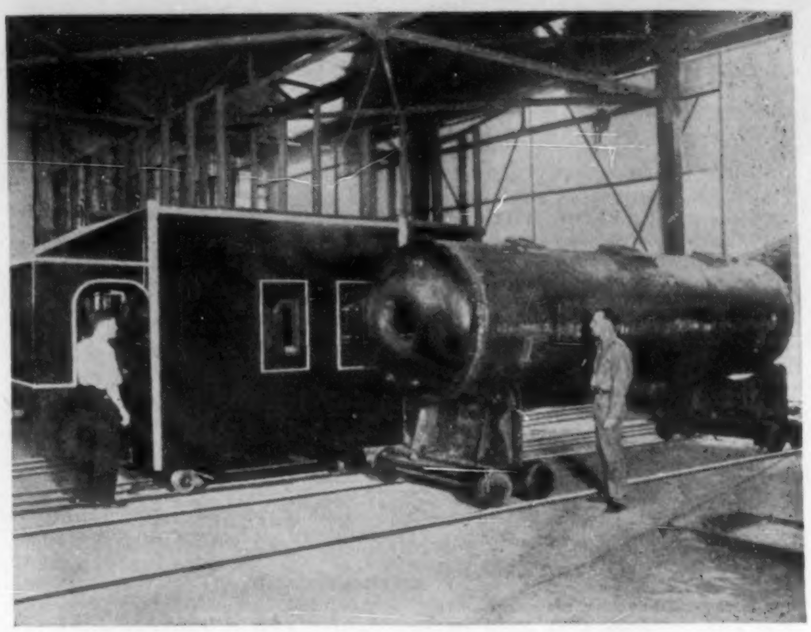
X-ray investigation pertaining to a zinc-gallate Ga_2ZnO_4 made up from ZnO and Ga_2O_3. The author proves that Al can be replaced by Ga in the zinc spinel without materially influencing the space lattice of the latter. EF (5b)

Investigation on the $\delta \rightarrow \gamma$ Transformation in the System Iron-Nickel (Untersuchungen über das Gebiet der $\delta \rightarrow \gamma$-Unwandlung in System Eisen-Nickel). H. Bennek & P. Schafmeister. *Archiv für Eisenhüttenwesen,* Vol. 5, Aug. 1931, pages 123-125.

After dealing with the results of previous investigations on the system Fe-Ni, the contradictory results of which are evidently due to the fact that the temperatures of equilibrium and the corresponding concentrations of the phases are effected by the cooling velocities, the authors re-established the diagram up to 50% Ni. The diagram is in satisfactory agreement with those established by D. Hansen & J. R. Freeman, *Journal Iron & Steel Institute,* Vol. 167, 1923, pages 301-321, and T. Kasé, *Science Reports Tohoku Imperial University,* Vol. 16, 1927, pages 491-513. GN (5b)

Separation and Changes of Properties in Supersaturated Silver-Copper Alloys (Entmischung und Eigenschaftsänderungen über sättiger Silber-Kupferlegierungen). N. Ageew, M. Hansen & G. Sachs. *Mitteilungprüfungsanstalten,* Sonderheft 18, 1931, pages 1-15; *Zeitschrift für Physik,* Vol. 66, Dec. 3, 1930, pages 350-376, 10 references.

The silver-rich and the copper-rich ends of the system were examined by X-ray methods with precision measurement of the lattice constants, by hardness measurements and by electrical conductivity measurements on quenched and annealed specimens. The equilibrium diagram is of the same type, showing maximum solid solubility at the eutectic temperature 779° C., diminishing with decreasing temperature. About 8½% Cu is soluble in Ag, and about 7% Cu in Ag at 779° C. At 200° C., however, only about 0.5% Cu is soluble in Ag, and less than 0.1% Ag in Cu. The work is largely concerned with a study of supersaturated alloys, one of 10.5% Ag in Cu quenched from 770° C. and annealed 24 hours at 300° C. has a lattice constant of 3.609 against 3.608 for pure Cu. The separation of the Ag is shown to be complete in 24 hours at 300° C. Precipitation of 50% of the Ag occurs in 9 hours at 300° and 190 hours at 250° C. Annealing the quenched alloy at 300° C. decreases the electrical resistance some 17% and raises the Brinell hardness from 65-70 to 90-95. Long annealing reduces the Brinell slightly below its maximum value in the 10.5% Ag alloy, but annealing even at 400° C. does not appreciably affect the Brinell of a 3.5% Ag alloy. Similarly, on the Ag-rich end, a 7.5% Cu quenched alloy annealed ½ hour at 250° or 10 hours at 200° C. rises from 60 to 150 Brinell, then falls to 110 or below on longer anneals, while an alloy of 2.3% Cu is practically unchanged at about 38 Brinell in hardness by long anneals at 200° and 250° C. and for the first 10 hours at 300°, but in 100 hours rises to 50 Brinell. Alloys of intermediate compositions show intermediate behavior. Quenching speed (cold water versus hot water or oil) has a large effect on the maximum hardness obtained on annealing. The alloys of 6.3% Cu with Ag and of 10.5 Ag with Cu both show a smaller decrease in resistance on annealing than is calculated by the rule of mixtures, by about 10%. Some abnormal effect is present which has not yet been clarified. From the similarity of the two ends of the system, it is probable that the same cause is working in both cases. When either Cu or Ag is precipitated from the supersaturated solid solutions, the appearance of some X-ray lines indicate that the precipitation does not occur uniformly throughout the mass, but that the solute is completely precipitated from portions of the alloy while other portions remained unchanged. The smearing of the diffraction lines of the newly formed lattice may be indicative of the formation of very small crystals or of strained crystals. Comparison of the intensity of the diffraction lines due to the new lattice with those due to the original lattice allow estimation of the fraction of the solute precipitated by any "aging" treatment. Upon "aging" a supersaturated Ag-rich single crystal was transformed into a multicrystal mass. HWG (5b)



Limits of Error for Piston Pins (Kolbenbolzen-Toleranzen). E. Koch. *Maschinenbau,* Vol. 10, July 2, 1931, pages 450-452.

The difficulties in accurately determining the limits of error in bored pistons and piston pins are discussed. It is shown that these parts cannot be interchanged, and that it is not yet possible to produce those which may be interchanged. MAB (6)

Plasticity Tests with Steel Pipes (Fliessversuche an Stahlrohren). *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Mar. 28, 1931, page 387.

Tests with combined stress of maximum 15 ton tensile strength and 150 mkg. torques on 400 mm. long pipes confirmed the usefulness of the formulas of Hencky. Ha (6)

Accelerated Cracking of Mild Steel (Boiler Plate) Under Repeated Bending. Rosenhain & Murphy. *Engineer,* Vol. 151, May 22, 1931, page 566.

Abstract of paper read before the Iron & Steel Institute May, 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 247. LFM (6)

Magnetic Method of Testing Welds. *Machinery,* Vol. 37, Apr. 1931, pages 624-625.

Only rather superficial defects can be detected by magnetic tests with iron filings strewn over the weld. The application of this method is illustrated. Ha (6)

One Million Pound Testing Machine for Testing Wire Rope Specimens. Trevor N. Treen & T. Avery. *Scale Journal,* Vol. 18, Oct. 1931, pages 3-4.

A detailed description of a machine for testing wire rope samples of 11 in. maximum circumference and 6 ft. unstretched length to a capacity of 1,000,000 lbs. The machine is equipped with automatic recording apparatus and electrically propelled and controlled poise. Ha (6)

Testing Methods for Cast Iron (Beproevingsmethoden voor Gietijzer). E. B. Wolff. *De Gieterij,* Vol. 4, Oct. 1930, pages 164-168.

The author discusses the various mechanical testing methods applied to cast iron and concludes: (1) the practice of large test pieces should be continued but with a better standardization of casting practice; (2) test pieces should not form part of the casting; (3) bending tests are more important than tensile tests; (4) division into 4 classes with tensile strengths of 14, 18, 22 and 26 kg./mm.^{2} is desirable; (5) the diameter of the test pieces should agree somewhat with that of the casting by dividing castings into 3 groups, viz., those thinner than 20 mm., those having dimensions between 20 and 50 mm. and those exceeding 50 mm. in diameter. HSvK (6)

The Deformation Process in Test Bars (Beiträge zum Verformungsvorgang im Zerreisstäben). *Stahl und Eisen,* Vol. 51, Sept. 3, 1931, pages 1116-1117.

Discussion between N. Dawidenko, G. Sajzew & W. Tafel on the paper by W. Tafel & H. Scholz in *Archiv für Eisenhüttenwesen,* Vol. 3, Feb. 1931, pages 545-552. See *Metals & Alloys,* Vol. 5, July 1930, page 629. GN (6)

Detecting Deformation of Shafts. O. P. van Steewen. *American Machinist.* Vol. 75, Oct. 1, 1931, pages 530-532.

The testing machine consists of 5 parts: (1) a large lathe resting on a firm base, (2) a framework which runs along the ways of the lathe and a caliper gage for measuring the diameter of the object, (3) an instrument for marking the outside wall of the object, (4) a horizontal comparator for measuring the distances and variations between the markings before and after every treatment of the object under observation, (5) an arrangement whereby the temperature can be kept within certain limits. The machine is in use in the shops of the A. E. G., Berlin. Ha (6)

Hardness Testing Superhard Materials. A. F. Shore. *American Machinist,* Vol. 75, Aug. 6, 1931, page 238.

Nitrided steels, tungsten and tantalum carbides can no longer be tested for hardness by the usual routine methods because of their immense hardness. Tests must be applied that disregard surface conditions and take a reading slightly below the surface. A chart is given showing, for different metals, the penetration depths and the force required for it. The penetrator is a hemispherical diamond. The method is described briefly. Ha (6)

A Magnetic Testing Method for Boiler Tubes (Ueber ein magnetisches Verfahren zur Prüfung von Kesselrohren). F. Wever & A. Otto. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 12, No. 24, Report No. 169, 1930, pages 373-387; *Stahl und Eisen,* Vol. 51, Apr. 1931, pages 466-468.

The authors developed a magnetic testing method for tubes. After preliminary tests with various types of d.c. and a.c. magnetizing, a dispersion current method with d.c. magnetizing was used. The magnetizing coil together with the testing coil is running over the tested tube with constant speed. In magnetizing the tube with constant magnetizing force, electromotoric forces are brought about in the testing spool by the dispersion fields which originate at the locations of magnetic disturbances. The testing spool is connected with a galvanometer. In testing low carbon steel tubes, 2 distinct types of magnetic disturbances were observed whether a high or a low magnetizing field strength is used. Cold work as it locally occurs while the tubes are straightened after annealing and non-uniformity of the structure are detected with the low field strength. Periodical changes of the diameter of the tubes, as caused by cold drawing, are detected with a high field strength. In further tests it is shown that cracks, inclusions and other failures can be detected which would not have been observed otherwise. GN (6)

A New Type of Testing Machine. *Foundry Trade Journal,* Vol. 45, July 30, 1931, page 75.

A description of the recently developed Tensometer, a small portable combination tensile-and Brinell-testing machine, weighing only 20 lb. The article is accompanied by 2 figs., one showing the plan and elevations of the machine, and the other a photograph. The test pieces used in the machine measure 0.6275 in. between the shoulders and have a diameter of 0.1593 in. OWE (6)

Fatigue of Metals and Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with A.S.T.M. Research Committee on Fatigue of Metals.

Accelerated Cracking of Mild Steel (Boiler Plate) under Repeated Bending. W. Rosenhain & A. J. Murphy. *Iron & Coal Trades Review,* Vol. 122, May 8, 1931, pages 739-743; June 12, 1931, page 951.

With discussion. In the course of investigations on a considerable number of failures in boiler plates and tubes, evidence has been found that the damage has been done at points where local flexure may occur as a result of changes of pressure and temperature. In order to imitate these stresses, test pieces from boiler plates were subjected to bending backward and forward through an angle of 15° each way and the number of bends after which the first visible crack appeared determined. The pieces were bent in air and immersed in water, brine and caustic soda solution. The surrounding medium did not have any great influence for short durations, but after 24 hrs., the endurance is markedly reduced in the tests with brine and water; water is more severe than brine. Micrographs are reproduced. Ha (6f)

An Investigation of Steels for Aircraft Engine Valve Springs. A. Swan, H. Sutton & W. D. Douglas. *Proceeding Institution Mechanical Engineers,* Vol. 120, Feb. 1931, pages 261-299.

The cause of failures in valve springs which have to perform the most arduous duty in service were investigated by making static tensile tests, static torsion tests and fluctuating torsion tests on a high quality steel wire from which springs were made. The apparatus and methods of these tests are described in detail. From the detailed reproduction of test data, the following results are stated. Most of the wires examined show pronounced decarburization at the surface. Removal of the surface layer has the effect of increasing the apparent safe range of stress and of reducing the variability. Oil-quenching from temperatures relatively low, but sufficiently high to secure effective hardening, followed by tempering at a normal temperature gave the best endurance properties. A possible explanation of the relatively low ratio of fatigue range to tensile strength of the harder wires lies in the residual stress following the hardening and tempering operations. Tests have revealed that considerable compressive residual stresses were present in the outer layers of heat-treated test pieces. For further details, the paper must be referred to. Ha (6f)

Crackless Plasticity, a New Property of Metals. H. F. Moore (University of Illinois). *Iron Age,* Vol. 128, Sept. 10, 1931, pages 674-677, 721.

An important property of steel is its ability to stand occasional overstress without the development of a crack which, in subsequent service, spreads to failure. Crackless plasticity of steel is not dependent on ductility as measured in tension or cold-bend-test. Suggested methods of experimental study includes fatigue tests following a period of overstress, notched bar impact tests and tests of damping of vibrations in the metal. Heat treated spring steel, as well as heat treated alloy steel, does not show a high degree of crackless plasticity under repeated stress. Another indication of the importance of crackless plasticity of metals is found in the behavior of notched specimens under repeated stress. VSP (6f)

The Increase of Fatigue Strength of Notched Constructions (Zur Steigerung der Dauerfestigkeit gekerbter Konstruktionen). A. Thum. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Oct. 24, 1931, pages 1328-1330.

Frequently notch effects cannot be avoided in structures because of the requirements of shape, arrangement of oil holes, etc. The author describes a method of producing stresses in the piece as an effective means of counteracting the notch effect. These inner stresses must be arranged in such a manner that they create, by a plastic deformation in the surface, a compressive tension which acts like a clamp around the notch and tries to protect it against formation of cracks which usually lead to fracture later. Ha (6f)

High Frequency Endurance Tests of Light Alloy Sheet Materials. *National Advisory Committee for Aeronautics,* 17th annual report 1931, pages 34-35.

Endurance limits at 12,000 cycles/min. were determined on high-frequency air-driven flexural endurance machines at the Bureau of Standards. (See *Metals & Alloys,* Vol. 1, Oct. 1929, page 145; Jan. 1930, page 332). Results were:

Alloy	Composition Cu	Mn	Mg	Si	Treatment	Direction of Specimen	Endurance Limit lbs./in.^{2}
17 ST	4	0.5	0.5	—	Quenched & Aged	L & T	15,000
25 ST	4.5	0.8	—	0.8	Quenched & Aged	(L	14,000
						(T	15,000
25 SW	4.5	0.8	—	0.8	Quenched Not Aged	(L	11,000
						(T	13,000
51 ST	—	—	0.6	1.0	Quenched & Aged	L & T	13,000
51 SW	—	—	0.6	1.0	Quenched Not Aged	(L	10,500
						(T	13,000
2 SH (Com'l Al)	—	—	—	—	Hard Rolled	L & T	10,000
3 SH	—	1.25	—	—	Hard Rolled	L & T	12,000
M H (Com'l Mg)					Hard Rolled	L & T	6,000
M AH	4% Al, 0. 4% Mn, bal. Mg					L & T	5,000 to 6,000

The method was not applicable to these materials in the annealed state, to heat-treated Alclad or to steel. Endurance testing to 100 million cycles in motor-driven flexural machines at 900 cycles/min. gave 16,000 lbs./in.^{2} for longitudinal and 14,000 for transverse specimens on quenched and aged 17 ST. Alclad 17 ST, i.e., the same alloy with Al layers on the surfaces of the sheet, similarly quenched and aged, showed 10,500 lbs./in.^{2} in both directions. A "special" 17 ST (composition not given) quenched and aged showed 19,000 lbs./in.^{2} longitudinal and 21,000 transverse. The same as Alclad, i.e., with Al layers, gave 13,000 longitudinal, 11,200 transverse. HWG (6f)

Surfaces. *Metallurgist*, Jan. 1931, pages 3-4.

Recent work on the effect of alternating stress on metals has called attention to the effect of the condition of the surface. Heat treated spring plates, for example, in the condition as ordinarily manufactured develop only a fraction of the true fatigue strength of the material but this can be closely approached by the same plates if they are first ground and polished in order to remove the rough surface layer. Surface decarburization, pitting or roughening from oxidation, and minute surface cracks resulting from quenching operations have been suggested as causes. Surface corrosion also causes loss of endurance strength. The requirement of resistance to corrosion is best met by materials which protect themselves by the spontaneous formation of a resistant surface film. The plating or covering of one metal with another such as chromium plating and the coating of aluminum alloy with pure aluminum are examples. Such coatings, however, must be deposited free of stress since, if the piece is subjected to alternating stress, the initial stress of the coating becomes superposed on the working stress and cracking of the surface layer may result. If this occurs, the crack will generally be propagated through the underlying steel, causing failure below the endurance range of the uncoated steel. The difficulties connected with the use of surface coatings would suggest that the soundest direction for future progress is likely to lie in the development of spontaneously corrosion-resisting materials of the type of the rust-resisting steels. VVK (6f)

Influence of Corrosion on Fatigue of Notched Specimens. T. S. Fuller. *Mining & Metallurgy*, Vol. 12, Oct. 1931, page 446.

Results of tests with a Ni steel of 3.5% Ni and 0.35% C, which was notched in a definite manner: The basis for consideration is the endurance limit of 58,000 lbs./in.^{2} of the unnotched specimen. In air at room temperature in the absence of corrosion, the value was reduced by notching to 32,000 lbs. by exposure to an atmosphere of wet steam and air to 31,000 lbs., then tested with a jet of steam playing directly on the notched section, to 27,000 lbs. The tests are described in detail. Ha (6f)

"Damping" of Materials under Alternating Stresses. *Metallurgist*, Jan. 1931, pages 13-15.

An extended abstract of a paper on this subject by Dr. O. Föppl in *Zeitschrift Verein deutscher Ingenieure*, Oct. 4th, 1930. The view held some years ago that the onset of plastic distortion was the feature that controlled the fatigue strength of a material has now been definitely discarded. On this view, the limiting fatigue strength coincides with the elastic limit, but it is now well known that the fatigue range may be high enough to allow a small amount of plastic distortion to occur during each stress cycle. It is stated that in some steels the fatigue strength is more than 4 times the highest stress at which the distortion can be said to be purely elastic. When a material is subjected to alternating stress under which the distortion is partly elastic and partly plastic, it is well known that some of the energy supplied is converted into heat in the interior of the material during each cycle, and another property of the material now comes into action, which, for want of a better term has been given the name "Dämpfung" in German, which may be rendered as "damping." The stress strain curve for a cycle takes the form of the familiar hysteresis loop, and the "damping" of the material, which is defined as the energy dissipated/cycle/unit volume, is given by the area of the loop. A non-dimensional damping number, known as the relative damping, φ, which is the ratio of the damping to the total energy of deformation stored in the specimen when strained to the limit of the stress cycle, is used. A steel of large damping capacity will not fail under vibratory stresses as quickly as one of small damping capacity. Methods of measuring damping are given. The relation between damping under direct stresses and under shear is also discussed. VVK (6f)

What We Know of Fatigue. *Engineering News Record*, Vol. 106, Apr. 16, 1931, pages 651-653.

A summary of present knowledge of endurance of metal under repeated stress and its correlation to treatment by heat and working. Ha (6f)

The Effect of Surface on the Fatigue Resistance of Spring Steels. Conditions Produced by Heat Treatment. *Iron & Coal Trades Review*, Vol. 123, Oct. 2, 1931, pages 489-490.

The following conclusions concerning the properties of spring steels have been derived from extensive experiments. Minute surface markings, probably cracks on the surface of quenched-and-tempered steels, do not seem to have any appreciable effect on the fatigue-resistance. Decarburization and other heat treatments show a reduction of the endurance fatigue limit of sometimes less than half if the value of the completely polished surface is taken as unity. The summary of results of rotating cantilever fatigue tests and plane-bending fatigue tests must be seen in the tables accompanying the paper. The tests show that the microscopic examination of a surface after normalizing is likely to be misleading where the original decarburized layer is possibly less than 0.001 in. deep. The mechanical explanation (that fatigue cracks commence in a soft surface layer which has an intrinsically low fatigue resistance and are then propagated by stress concentration into the more highly resistant material below) gives a general explanation of the fatigue failures at low stresses. In general, the tests suggest that the greater the decarburization of the surface layer, the lower is the fatigue resistance. It is probable that the intrinsic fatigue resistance of the surface layer is approximately proportional to its hardness and diminishes with a decrease in the C content. Where a high fatigue resistance is required in a hardened-and-tempered steel, the surface decarburization of the surface in the heat treatment should be eliminated or reduced to a minimum. Ha (6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Electroplating on Aluminum. Harold K. Work (Aluminum Company of America). *Metal Cleaning & Finishing*, Vol. 2, Sept. 1930, pages 777-780.

In plating commercially pure Al, the metal is cleaned, dipped for 10-15 secs. in 1 part 48-52% HF and 9 parts H_2O and rinsed in cold H_2O. It is then dipped in a solution of 37 oz. $NiCl_2$, 0.2 gal. HCl (sp. gr. 1.18), and 1 gal. H_2O at 75°-80° F. The time of immersion must be carefully determined by plating specimens with different periods in the dip, and then bending or breaking them. A good plate will not flake off in this test. A dip of 35 secs. usually gives good results. After rinsing the parts, they are plated at 15 amp./ft.^{2} in a bath of 19 oz. $NiSO_4$, 10 oz. $NaSO_4$, 2 oz. NH_4Cl, and 2 oz. H_3BO_3/gal. solution. Time of plating should be determined to give the desired corrosion resistance. Other Ni solutions such as are used on Zn may be substituted. After plating, the parts are rinsed in cold H_2O, dipped in hot H_2O, buffed, cleaned, and plated with any desired metal. In plating strong alloys and sheet containing Mn, the articles after being cleaned and dipped in HF are immersed at 75°-80° F. in ½ gal. HCl (sp. gr. 1.18), ½ gal. H_2O, and ½ oz. $MnSO_4.2H_2O$. The time of immersion must be carefully determined by experiment. The rest of the plating procedure is unchanged. The heat treated metal gives a plated product that is more resistant to corrosion than the untreated metal. Castings require still a different etching process. The etching solution consists of 3 parts HNO_3 (sp. gr. 1.42) and 1 part HF (48-52%) at 75°-80° F. Proper time must be carefully determined by test as in the other cases. Usually the proper time of dip is 15-30 secs. for die castings, and 60-120 secs. for sand castings. Containers for the dip should be Pb lined and painted with a mixtures of 1 part beeswax to 4 parts paraffin. MS (7a)

Chromium Deposits Directly on Aluminum. Harold K. Work & Charles J. Slunder (Aluminum Company of America). The *Metal Industry*, N. Y., Vol. 29, June 1931, pages 243-245.

Paper presented at the Electrochemical Society, Birmingham, Ala., April 1931. Using ordinary chromium plating baths, light and heavy chromium deposits on aluminum were obtained. Corrosion resistance was good both to outdoor exposure and to mild alkalies. 7 references. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 174. PRK (7a)

Comparative Measurement of Throwing Power in Electroplating Practice. L. K. Wright. *Metal Industry*, N. Y., Vol. 28, Nov. 1930, pages 522-523; *Oberflächentechnik*, Vol. 8, July 7, 1931, pages 142-143.

Several methods have from time to time been advocated but usually results represent nothing of great value in commercial applications. Method advocated by the author is one which utilizes an instrument in which tubes are quickly inserted and tested. The instrument consists of a rubber plate, wherein is the current distribution plate, the center of which is pierced and threaded to receive a test tube, the same being inserted from the rear. The instrument requires very little calculation, is simple and capable of presenting accurate data. Ha+VSP (7a)

Electroplating on Aluminum from Cyanide Solutions. H. K. Work. *Preprint, American Electrochemical Society*, Vol. 60, Sept. 1931, pages 53-57; *Metal Industry*, N. Y., Vol. 29, Oct. 1931, pages 436-437.

Of the various cyanide plating baths, the cyanide zinc bath containing no strong alkali proved most practical. Details follow:

Bath composition:	g./l.	oz./gal
$Zn(CN)_2$	30	4
NaCN	30	4
Ammonia water, 28%	30	4
Peptone, or	1	0.12
Gelatin	5	0.67

Temperature: 20°-23° C.
Current density: 0.5 amp./dm.^{2}, 5 amp./ft.^{2}.
Preliminary treatment: Cleaning in mild alkali, followed by pickling in 5% HF. PRK+LCP (7a)

Chromium Plating for Wear Resistance. Robert D. Zimmerman (Ingersoll Rand Co.) *Iron Age*, Vol. 127, June 18, 1931, pages 1982-1984.

Supplement to an article appearing *Iron Age*, Vol. 127, June 4, 1931. Anodes vary in size from 1/16 in. to 24 ins. Production fixtures consist of: (1) those for plating a number of similar parts at the same time; (2) those for plating a number of identical parts. Usual amount of plate removed in grinding is about 0.003 in. on the diameter of a round piece. Discusses plate finishing. VSP (7a)

Pure Zinc Galvanizing Process. L. D. Whitehead. *Wire & Wire Products*, Vol. 6, June 1931, pages 223-225.

In hot-galvanizing iron, the zinc is always, and unavoidably, contaminated with iron, to the extent of at least 2½%. The value of pure zinc as a protective agent is in this manner considerably reduced. In the new electric galvanizing method which is described, the wire, after being drawn, is taken straight to the galvanizing shop without any other preparation. Then the wire is first drawn through a lead annealing furnace which keeps the temperature within very narrow limits; passed through a very dilute acid bath as a cleanser; and wound over drums, one of which is immersed in the galvanizing bath. Only a very small galvanizing tank is necessary, as compared with the long ones required for the hot process. As the zinc is deposited in its purest form, a thinner coating suffices; moreover, it is not brittle and has a greater ductility. If 1/3 of the weight which must necessarily be deposited by the hot galvanizing method is deposited electrically, it is shown to give the same resistance to corrosion. A coating of equal thickness, deposited electrically, has a resisting power 10 times as great as that deposited by the hot-galvanizing process. Another consideration in favor of the electrolytic process is that there are no noxious fumes present as in hot-galvanizing. Ha (7a)

Working Methods in Chromium Plating (Die Arbeitsmethoden der Galvanischen Verchromung). *Oberflächentechnik,* Vol. 8, Apr. 7, 1931, pages 77-79.

Valuable information covering the working methods used in chromium plating. Description of the detailed chemical processes occurring in the course of plating and the conditions favoring the formation of bright, dull, burnt, highly corrosion-resistant and tenaciously adhering coatings. Thus, for corrosion-resistant and tightly adhering chromium coating and nickel as intermediate layer, the strict adherence to the following rule must be observed: Nickel bath: pH value, 5.2-5.8; temperature of bath, 40-50° C.; metal salt concentration, as high as possible; thickness of coating, 0.025 mm. Chromium bath: 15-20 min. at 3.4-3.5 volts; current density, 5-15 amp./dm.^{2} for cathodic surface; temperature of bath, 30-45° C.; bath concentration, 32-35° Bé; lead as anode and ratio of anodic surface to cathodic 1.5:1. Bad nickel-chromium double coatings can be removed conveniently electrolytically—material involved as anode, lead as cathode, 5-8 volts, anodic current density 1.5 amp./dm.^{2}, sulphuric acid of 56° Bé, as electrolyte, to which is added either arsenic acid or lead acetate. ER (7a)

Electrometallurgy (7b)

Electrolytic Refining of Aluminum and Aluminum Alloys in a $AlCl_3$-NaCl Melt. (Elektrolytisches Raffinieren des Aluminiums und Aluminieren in einer $AlCl_3$-NaCl-Schmelze.) W. A. Plotnikow, N. S. Fortunatow & W. P. Maschowetz. *Zeitschrift für Elektrochemie,* Vol. 37, Feb. 1931, pages 83-88.

The electrolytic refining of aluminum is a useful process for obtaining very pure aluminum and for separating the metal from its alloys in scrap, borings and the like. The principal value of electrolytic refining, however, lies in the possibility of obtaining the metal from relatively low-grade ores and purifying it, at a lower operating cost than that incurred in prevailing metallurgical methods. The difficulty is in finding an electrolytic process which fully meets the requirements both of efficacy and economy. An essential factor in success is to find a suitable non-aqueous electrolyte, in which the electrolysis can be effected at a moderate temperature. In an investigation made at the Ukrainian Academy of Sciences, at Kiev, various double salts containing aluminum were studied with this in mind. The best results were obtained with aluminum and sodium chlorides, which were used as long ago as 1854 for electrolytic preparation of aluminum metal. By suitable proportioning of the chlorides and proper choice of conditions, it was found possible to refine aluminum even when its iron content is very high. Iron and copper are the only cathode metals on which satisfactory deposits were obtained. (7b)

The Refining of Silver. C. Campbell. *Electrical Review,* Vol. 109, Aug. 21, 1931, page 275.

The electrolytic method is now the most satisfactory; the Balbach-Thum process is the most generally applied in England. To secure uninterrupted operation and prevent losses by defective deposits, 2 sets of tanks are always run in parallel. The current density is maintained at 50 amp./ft.^{2}. The cells consist of shallow glazed porcelain troughs with horizontal bottoms lined with Acheson graphite. The graphite forms the cathode; the deposit is permitted to form on top of the cathode for the period of one shift (8 hrs.), after which it is removed. The area of the cathode is about 8 ft. square. The anodes are plates of crude Ag otbained from various melting operations. The electrolyte consists of a 0.5% solution of nitric acid; the Ag content is maintained at 3%. The Ag obtained has a purity of 99.9% of Ag. The remainder is made up of 0.02% moisture, 0.03% C, 0.001-0.005% Au. The treatment of the anode slimes containing 90-94% Au, 4% Pt and 0.4% palladium, and the separation of these metals is briefly described. The importance of maintaining a constant flow of fresh air to remove the noxious nitric oxide fumes is noted. Ha (7b)

Production of Magnesium by the Electrolysis of Fused Fluorides containing Magnesium Oxide (Die elektrolytische Gewinnung des Magnesiums aus Magnesiumsoxydhaltigen Fluoridschmelzen). G. Grube & H. Henne. *Zeitschrift für Elektrochemie,* Vol. 36, Mar. 1930, pages 129-138; *Chimie et Industrie,* Vol. 24, Sept. 1930, page 607.

In this investigation, the authors used calcium fluoride instead of barium fluoride. As a part of their work they determined the equilibrium diagram for a mixture of fluorides. It was found that the most interesting of 2 ternary eutectics was a combination of $MgF_2 \cdot CaF_2$ and $MgF \cdot NaF$ (melting point 894° C.). The electrolysis was carried out in a copper crucible with an iron cathode and a graphite anode. The cathode was surrounded by a copper bell in which there was a H atmosphere. Several mixtures were used at temperatures 40° C. above their melting point. It was found that the mixture of the eutectic composition gave only Mg. If barium fluoride was added to the bath as a fourth constituent, the current efficiency, which is a function of the cathode current density, increased. As a result the temperature of the electrolysis was lowered but Na appeared at the cathode. These results confirm on the whole those of previous investigations. (7b)

Electro-Metallurgical Deposition. *Electrical Review,* Vol. 108, June 12, 1931, pages 983-984.

The fundamentals of metal deposition from electrolytes are explained briefly. The importance of ascertaining the polarization of electrodes for the determination of the voltages to be applied in the process are discussed and the connections between tanks and dynamos and dimensions of electrodes are described. Ha (7b)

An Electrolytic Method of Preparing Alkaline Metals in Discharge-Tubes (Eine elektrolytische Darstellungsmethode von Alkalimetallen in Entladungsröhren). M. Forro & E. Tatai (University of Budapest). *Zeitschrift für technische Physik,* Vol. 12, Apr. 1931, pages 256-262.

An electrolytic method was developed for the deposition of alkaline metals in vacuo. The experiments refer to K, Rb and Cs. EF (7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

The Surface Treatment of Aluminum (Die Oberflächenbehandlung von Aluminium). *Oberflächentechnik,* Vol. 8, Sept. 1, 1931, pages 187-189; *British Industrial Finishing,* Vol. 2, May 1931, pages 76-80; June 1931, pages 102-104.

Surface treatments comprise 2 groups, one mechanical and one chemical and electro-chemical. In all cases, an entirely clean surface is required. Solutions for degreasing and deoxidizing are mentioned. One mechanical treatment consists of heating the Al to 300-500° C., depositing a layer of Sn and then pressing on under hydraulic pressure a thin, cleaned sheet of heavy metal. Lautal, Duralplat and Alclad are similar products. Covering with paints, lacquers or enamels also belongs in this class. It is briefly treated and recipes are given. Of the chemical, the electro-chemical coating methods are most important. Electrolytic bath recipes are given and methods for plating with Ni, Cu and Zn are explained. The 2 latter metals can be deposited also in a physico-chemical process by boiling the Al in suitable solutions. Colored coatings can be obtained by the Fescol and Alumilite processes. A solution is given for obtaining a fine black color on Ni plated Al with steel anodes. Ha (8)

Metal Spraying as Protection Against Corrosion (Das Metallspritzverfahren als Schutz gegen Korrosion). H. Pauschardt. *Korrosion & Metallschutz,* Vol. 7, June 1931, pages 139-145.

Includes discussion. After briefly summarizing the theory and process of metallic spraying in the introduction, the author reports his own experiments carried out with sprayed metallic plates exposed to atmospheric and liquid attack of various degrees of severity. The primary interest was the prevention of corrosion in sea-water and of the growth of marine animals and vegetation. The materials employed for the spray and coating, respectively, were as follows: (1) cadmium; (2) zinc + bakelite coating; (3) zinc + mercury layer (particularly against maritime animals); (4) zinc + tin + bakelite; (5) aluminum-bronze (Al-Cu); (6) aluminum + zinc + bakelite; (7) aluminum + zinc. An additional set of experiments refer to Al-plates coated by a metallic spray of Cd. The original paper, presented before the Reichsausschuss für Metallschutz, Kiel, 1930, must be consulted for the wealth of results which are set forth in a large table. EF (8)

An Electric Galvanizing Furnace Permits Close Temperature Control. S. Z. Owen (Westinghouse Elec. & Mfg. Co.). *Electric Journal,* Vol. 28, Nov. 1931, pages 631-632.

An electrically-heated galvanizing furnace has been installed for work on small castings, conduits and pipes, and similar material in street-lighting equipment. Its rating is 75 kw. 200-v., 3-phase. The vessel weighs over 2 tons and holds 8 tons of spelter. The 6 heating elements—2 on each side and one at each end—are made of Ni-Cr resistance wire supported in porcelains and are easily removable without disturbing the vessel. The enclosing shell serves as a mounting for insulators, jumpers, terminal boards and covers, and as a support for an insulated hinged cover. The cover, in 2 halves for convenience in operation, is made by an inner alloy sheet and a top steel sheet, filled between with 3 inches of mineral wool insulating material. Thermocouple control of the chamber temperature and bath temperature insure close temperature control. WHB (8)

Homogeneous Lead Deposition with the Aid of the Oxy-Acetylene Blow Pipe. *Welding News,* Vol. 2, July 1931, pages 20-21.

At the present time, industry makes use of a Pb covering of metals which is carried out in 2 ways: (1) on all metals, by means of sheets of Pb suitably shaped and fixed in position by oxy-acetylene welding; (2) chiefly on steel, by depositing molten Pb by means of the blow pipe on all the surfaces to be protected. The procedures are described in general. Steel is often tinned first to assure an absolutely dense and homogeneous Pb covering. Ha (8)

New Methods and Equipment Aid Coating Industry. *Steel,* Vol. 88, Jan. 1, 1931, pages 288, 361.

The past year has seen many improvements in the enameling, pickling, galvanizing and polishing of metals. These include 2 new continuous furnaces for porcelain enameling, an acid-proof reinforced concrete tank for pickling, the use of small percentages of Al in zinc for galvanizing, better methods of galvanizing sheet and wire, of handling dross, and of regulating the speed of galvanizing machinery, and the development of machines for polishing sheet, tin plate, and stainless steels. JN (8)

Advantages of Oxide Films as Bases for Aluminum Pigmented Surface Coatings for Aluminum Alloys. R. W. Buzzard & W. H. Mutchler (Bureau of Standards). *Technical Note* No. 400, *National Advisory Committee for Aeronautics,* Nov. 1931, mimeographed. 16 pages, 13 figures, 10 references.

Anodic coatings on aluminum alloys, produced by electrolysis in sodium-hydrogen phosphate, ammonium hydroxide, ammonium sulphide, oxalic acid, sulphuric acid, or chromic acid, especially chromic acid, have some corrosion resistance, but it is not very great. Pure Al coatings, as in Alclad, offer the best resistance, but there is still a need for other protective methods. Varnish type coatings applied over untreated duralumin have only about the same degree of protection as a grease coating over an anodic film. Use of the anodic coating as a priming coat over which aluminum-pigmented varnish is applied, gives good results. Tests by the salt spray method, intermittent immersion in NaCl-H_2O_2 solution, on unstressed, on statically stressed specimens, and on specimens subjected to repeated flexural stresses as well as atmospheric exposure tests are recorded. They show that under all conditions of test the combination of anodic treated plus the aluminum pigmented spar varnish was far superior to either alone. The combination stood up for nearly 3 years in exposure tests at Hampton Roads; intercrystalline attack of the duralumin had just started in 3 years. Alclad duralumin similarly exposed showed no intercrystalline corrosion at all in 3½ years. HWG (8)

INDUSTRIAL USES & APPLICATIONS (9)

Nickel Alloys in Automotive Manufacture. THOMAS H. WICKENDEN. *S. A. E. Journal*, Oct. 1931, pages 328-331.

Many uses of Ni in the automotive industry are listed. It is used in cast iron to promote uniform hardness and good wearing qualities, in castings of varying section, without excessively hard spots. Cylinders, cylinder-heads, pistons, exhaust manifolds and brake-drums are among the chief engine and automobile parts in which nickel cast iron is used. It is also coming into extensive use in heavy dies for pressing fenders and large parts for automobile bodies. The discussion deals chiefly with the use and heat-treatment of nickel iron. The effect of annealing and heat-treatment on permanency of form and strength is touched upon, and vagaries of the expansion ratio of high-nickel-alloy steels are recounted. WAT (9)

The Surface Treatment of the Zinc for Use as Printing Plate (Die Oberflächenbearbeitung des Zinks zur Verwendung als Druckplatte). EUGEN WERNER. *Oberflächentechnik*, Vol. 8, Oct. 20, 1931, pages 215-217.

A detailed description of the development, the process and the preparation of zinc plates for zincotypography; that is, printing from prepared zinc plates instead of from stone or wood. Ha (9)

Refrigeration Units Require Quality Metals. H. M. WILLIAMS (Frigidaire Corp.). *Metal Progress*, Vol. 20, Aug. 1931, pages 39-45.

The author discusses the refrigerating cycle and necessity for corrosion resistance in materials of construction. Corrosion tests of various kinds are discussed. Development of ice tray materials, improved copper and brass parts in the evaporator, tubing and joining materials, control equipment and cabinet finishes are discussed. WLC (9)

Welded Cranes. H. SCHMITT. *Engineering Progress*, Vol. 12, Oct. 1931, pages 222-223.

General remarks on the advantages, with illustrations of examples. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 218. Ha (9)

The Effect of Short Circuit Currents on the Strength of Transmission Wires of Aluminum and Copper (Die Einwirkung von Kurzschlussströmen auf die Festigkeit von Leitungsseilen aus Aluminium und Kupfer). F. WOEHR. *Aluminium, Hauszeitschrift V.A.W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 271-276.

Tests to decide to what extent Al wires (in comparison with Cu wires) are reduced in strength by very large currents of short duration as they occur during short circuits are described. The beginning of a reduction in strength was found, for Al, at about 140°-150° C., for Cu at 170°-180° C. The duration of the short circuit up to one sec. had no influence. In stranded cables, all layers were influenced in the same way. From the economical point of view, the use of Al is often preferable. Ha (9)

Corona on Copper and Aluminum Wires (Korona an Kupfer- und Aluminiumseilen). F. WOEHR. *Aluminium, Hauszeitschrift V.A.W. Erftwerk*, Vol. 3, July-Aug. 1931, page 266.

General remarks on the nature and dependence on weather conditions of corona losses of transmission lines. Since the diameters of Al wires are usually larger, the corona losses are smaller. The following table gives the voltage in kw. for lines of different sections at which the corona just begins to appear:

Section mm.²	Material Aluminum Old	New	Copper Old	New
70	47	45	40	31
95	56	43	48	40
120	60	49	42	40

The condition of the surface is of importance as can be seen from the difference between the old and the new material. Ha (9)

Influence of Corona Phenomena on Transmission Wires (Einfluss von Korona-Erscheinungen auf Freileitungsdrähte). v. ZEERLEDER. *Aluminium, Hauszeitschrift V.A.W. Erftwerk*, Vol. 3, July-Aug. 1931, pages 267-269.

On the basis of theoretical considerations, experience and experiments, it is shown that overhead lines of Al and Al alloys (for instance, aldrey) behave just as well under the corona effect as Cu. The tests were of a chemical and physical nature; they are described in full. Ha (9)

Welded Steel Cases for Loading Coils. C. R. YOUNG. *Bell Laboratories Record*, Vol. 9, July 1931, pages 517-522.

Loading coils, that is induction coils, used to counteract the capacitance of electric cables must be carefully protected from atmospheric and other damaging influences. A method of placing them in welded steel cases is described. Ha (9)

Repair Delays Reduced by Oxy-Acetylene Welding. F. A. WESTBROOK. *Welding*, Vol. 2, Nov. 1931, pages 742-743.

The successful application of bronze and other welding rods has contributed greatly to the profitable operation of a western mine. Ha (9)

Steel Wire for Heading. JAMES VINCENT. *American Machinist*, Vol. 75, Sept. 3, 1931, pages 388-389.

For the manufacture of strong, reliable screws, a fully annealed medium C steel wire is recommended. After completion of heading, thread rolling and kerfing, the screws should be heat treated. The analyses of 2 suitable wire steels is given. Ha (9)

Manufacture of Lead Covered Telephone Cable. JOHN R. SHEA (Western Elec. Co.). *Iron Age*, Vol. 127, June 18, 1931, pages 1980-1981.

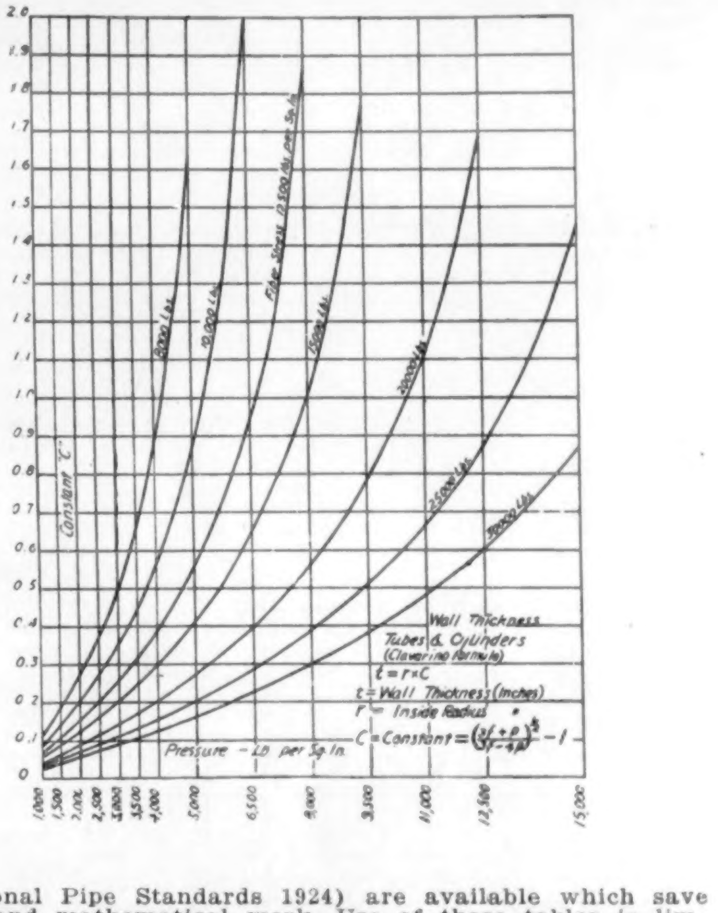
Abstract of paper read before the American Society of Mechanical Engineers, Cleveland. Discusses method of manufacture of Pb-covered, paper-insulated telephone cables at Point Breeze plant near Baltimore. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 262. VSP (9)

High-Tensile Steel Used in Boilers of New Locomotives. *Boiler Maker*, Vol. 31, Feb. 1931, pages 39-40.

A silico-manganese steel with a minimum ultimate strength of 70,000 lbs./in.² is used for the boiler shell and outer fire-box wrapper sheets. Complete data of the locomotive are given. Ha (9)

Curves Aid in Design of Thick-Walled Tubes and Cylinders. F. E. WERTHEIM. *Heating, Piping & Air Conditioning*, Vol. 3, Oct. 1931, pages 850-851.

When hydraulic presses were first used, fractured cylinders were far from being unknown and, consequently, cylinder walls were made heavier when cracked cylinders were replaced. Later, when it was found that increase in wall thickness beyond certain limits did not result in a corresponding increase in strength, investigation of the strength of thick-walled tubes and cylinders began. This subject was of such importance in connection with the design of guns that many attempts were made to originate a formula. Among these formulas were those of Bix, given in the "Konstrukteur" by Prof. F. Realeaux; of Grashof, given in Unwin's "Machine Design"; of D. K. Clark, Lame, Barlow, Birnie, and Clavarina. Burr and Lanza developed formulas giving results identical with the Lamé, and Merriman developed one producing results identical with Barlow's. Inasmuch as the modified Barlow formula has found a place in the A. S. M. E. Boiler Code, this comparatively simple formula will continue to find ready acceptance. For thick-walled tubes and cylinders subjected to internal strain, use of the Clavaino formula is good practice. In order to simplify the calculations for application of this formula, tables



(National Pipe Standards 1924) are available which save time and mathematical work. Use of these tables is limited, however, because they do not apply for calculations in which the known quantities are inside diameter, working fiber stress, and working pressure. The accompanying chart has been devised for use in the solution of problems involving the Clavaino formula. In making the computations for these curves, the form of the Clavaino formula given by Merriman was used. Merriman here assumes a value of 1/3 for Poisson's ratio, while the value now generally accepted is 0.3. Because these curves are intended to cover a wide range of application, and the Merriman form has been much used for important work, the writer has given it preference in the present instance. An example to show the use of these curves follows. Given: inside diameter 16 in., working fiber stress 15,000 lbs./in.², pressure 4,000 lbs./in.² t = r x C = 8 x 0.3 = 2.4 in., say 2 7/16 in. Therefore outside diameter is 16 + 4⅞ = 20⅞ in. WAT (9)

How Shipbuilding is Tied to the Steel Industry. H. GERRISH SMITH. *Iron Age*, Vol. 128, July 16, 1931, pages 166-169.

Taken from a paper read before the American Iron & Steel Institute in New York. Deals with the history of the transformation from wooden construction, first to Fe, then to steel. At present, about 99% of a ship is steel and 1% wood. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 218. VSP (9)

Some Uses of Tin in Modern Dentistry. F. C. THOMPSON. *Tin*, Sept. 1931, pages 6-8.

Tin is used to a great extent, especially in alloys of Sn and Ag for amalgam fillings. For general purposes, a composition of 67% Ag, 28% Sn, up to 4% Cu and up to 1% Zn is used. When mixing with Hg, a reaction takes place according to the formula $Ag_3Sn + 4Hg = Ag_3Hg_4 + Sn$. The filling becomes increasingly hard as this reaction proceeds because both the Ag-Hg compound and Sn are solid at ordinary temperatures. The compression strength is very great. Sn renders Au brittle, except in small amounts; a composition often used is 71.3% Au, 7.1% Ag, 9.9% Cu, 10.6% Pt and 0.83% Sn. Sn is also used in dies for swaging of crowns and bridges for which a table of compositions with their melting points is given. Ha (9)

Different Bronzes Used by the Railroad Companies (Les différents bronzes utilises par les Copagnies de Chemins de fer). R. LOISEAU. *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Apr. 1931, pages 203-208.

General consideration of 7 bronzes used by the railroad companies. GTM (9)

HEAT TREATMENT (10)

Deformations Accompanying the Heat-Treatment of Steel (Nouvelles recherches concernant les déformations accompagnant les traitements thermiques de l'acier). A. Portevin & A. Sourdillon. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 343-363; *Metallbörse,* Vol. 20, Aug. 23, 1930, page 1884.

Includes discussion and 34 figures. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 263. HWG (10)

Heating before Quenching and Drawing. *Houghton's Black & White,* Vol. 4, July 1931, pages 12-13.

The advantages of heating high speed steels in salt baths are pointed out, but the purity and homogeneity of the salt, the fluidity of the bath at working temperature and the ability to free itself from the steel are important points in obtaining uniform and efficient results. Ha (10)

Heat Treatment Fundamentals of Plain and Alloy Cast Iron. F. B. Coyle (International Nickel Co.). *Metals & Alloys,* Vol. 2, Sept. 1931, pages 120-131.

18 references are cited and 13 micrographs show structures discussed. The nature of cast iron and effects of heat on it are discussed in the light of the Fe-C equilibrium diagram. The effects of various elements on graphitization and critical ranges are shown graphically and are discussed. Constitution of Ni-cast iron is shown graphically. Use of aging and annealing operations to relieve casting strains and facilitate machining operation are discussed. Data is presented to show the relations between composition, temperatures used and the hardness obtained. The quenching and drawing of cast iron is discussed. WLC (10)

Heat Treating and Annealing Non-Ferrous Metals. A. H. Vaughan. *Fuels & Furnaces,* Vol. 9, Aug. 1931, pages 939-941.

A general discussion of the various types of electric furnaces in the heat treatment of non-ferrous metals and alloys. Ha (10)

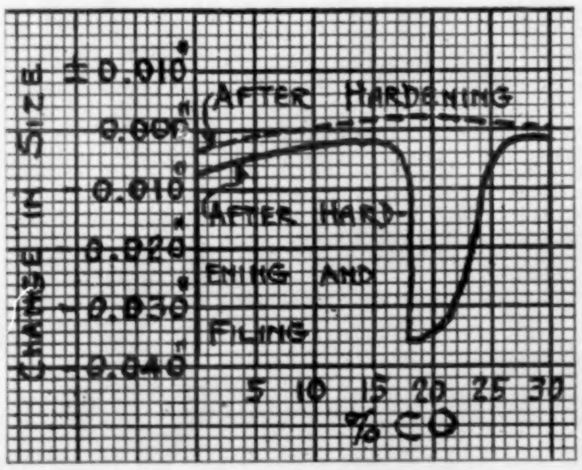
Hardening (10a)

Practical Limitations Often Prevent Perfect Hardening of Steel. Correspondence from A. Portevin, Paris, France. *Metal Progress,* Vol. 20, Oct. 1931, pages 88-89.

The writer presents graphically an analysis of the various factors effecting the proper hardening of steel, velocities available in quenching media, their effects on the properties, temperature of quench and its effects are discussed. WLC (10a)

What is a Neutral Atmosphere. Murray Winter (Winter Bros. Co.). *Metal Progress,* Vol. 20, Sept. 1931, pages 74-78.

The author reports a study of the effect of atmosphere upon the surface, surface hardness and size of small high speed steel tools. Atmospheres varying in CO content were produced from mixture of city gas and air. The CO content in the furnace was determined by analysis and controlled by a steady supply of a fixed mixture of gas and air. The graph summarizing these results shows concisely the effect of the atmosphere. At 17% CO, a good condition of tool surface is obtained but this gas analysis is very critical.



As shown, a small increase in the CO content results in decarburization until 25% CO content is reached where good tools free from decarburization and scale entirely, are obtained. With a gas mixture to maintain this atmosphere a troublesome deposit of soot is experienced. The author describes results obtained by the use of "diamond block," block of slow burning carbonaceous material which maintains an atmosphere of 28% CO in the furnace. Tools allowed to remain in such an atmosphere for as long as 20 mins. at the high temperature are not impaired in their surface quality or size. WLC (10a)

Annealing (10b)

Normalizing Steel. R. Whitfield. *Metallurgia,* Vol. 4, May 1931, pages 29-30.

Sorbitic steels have much better drawing properties than pearlitic steels. Sheets with this structure are produced by heating to the normalizing temperature and cooling at a rate sufficiently rapid to produce a sorbitic structure. A continuous furnace is best suited for this work. Mentions use of normalized sheets in stampings used in automobiles. JLG (10b)

Heat Treating Light Gray Iron Castings Decreases Difficulties in Machining. H. R. Simonds. *Foundry,* Vol. 59, Mar. 1, 1931, pages 58-62.

The annealing in continuous automatic heat treating furnaces of the Brown & Sharpe Mfg. Co., Providence, R. I., is described and illustrated. Ha (10b)

Case Hardening & Nitrogen Hardening (10c)

Nitriding for the Engineer. Oscar E. Harder (Battelle Memorial Institute). *Metals & Alloys,* Vol. 2, Sept. 1931, pages 132-142.

51 references are cited in the author's discussion of the present knowledge of the art of nitriding. Time of nitriding is discussed with modified cycles for shortening. The use of a high and a low temperature, the use of catalyzers, packing materials and continuous nitriding are discussed as they apply to the economy of the process. Cost of equipment, materials and savings through low rejects on account of warpage are referred to. Hardness obtainable with various treatments is given. Dimensional changes with time of nitriding are discussed. The protection of parts and containers against nitriding with the effect of a nitrided container on subsequent work done in it are discussed. The composition and properties obtainable from the various nitriding steels are given in tabular form. Heat treatment for core properties prior to nitriding and other preparation for nitriding are discussed. Hardness penetration curves are shown and discussed. The properties at elevated temperatures are discussed with the effect of temperature on the subsequent properties at room temperature. Creep tests, wear and abrasion resistance and corrosion resistance of nitrided steels are discussed. The stability of nitrided cases and their applications are touched upon. WLC (10c)

Surface Hardening by Nitrogen of Special Aluminum-Chromium-Molybdenum Steels on a Production Basis. W. H. Cunningham & J. S. Ashbury. *Iron & Coal Trades Review,* Vol. 123, Oct. 2, 1931, pages 492-494.

The paper explains the process of nitriding, the chemical changes taking place, testing method for hardness. It also describes the equipment necessary for nitriding on a commercial basis. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 309. Ha (10c)

Oil as a Carburizing Medium. A. J. Lindberg (Lindberg Steel Treating Co.). *Metals & Alloys,* Vol. 2, Sept. 1931, pages 106-109.

The author describes equipment for gas carburizing using oil introduced into the retort as a source of carburizing gas. The use of a diffusion period at the end of the cycle to improve the distribution of the C is discussed. WLC (10c)

Nitrided Steel and its Properties. J. H. Higgins. *Heat Treating & Forging,* Vol. 16, Dec. 1930, pages 1527-1529.

A brief outline of the process and the various steps in nitriding are given and the influence of temperature and composition of the steel are discussed. Ha (10c)

Nitrided Steel and Nitriding Furnaces (Om nitrerstål och nitrerugnar). Eimar Oehman & Erik S. Engberg. *Jernkontorets Annaler,* Vol. 115, June 1931, pages 208-230.

A description is given of the steels which are suitable for nitriding; of the pre-treatment before nitriding; the quality of the nitrided steel; and of the furnaces used. The furnace used by Luth and Rosen (Stockholm) has a volume of 1500 × 600 × 400 mm., the upper part of which is balanced by a counter-weight so that it may readily be raised or lowered. Heat is generated by electricity; the parts exposed to heat are made of fire-resistant brick; insulation is provided by 150 mm. of Mg and sil-o-cel; resistance wires are chrome nickel and 24 + 8 kw. are necessary to maintain 700° C. Ammonia is provided by rubber hose, which is not allowed to dissociate beyond 25%-30%. Control is effected by a Siemens CO_2 meter. Current is controlled by a Siemens relay which maintains the temperature within 30° C. HCD (10c)

Nitriding or Case-Hardening with Ammonia. V. O. Homerberg & J. P. Walstead. *Machinery,* Vol. 37, Oct. 1930, pages 106-108.

The general principles of this process and the physical properties of materials that can be nitrided are described. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 309. Ha (10c)

Theoretical and Practical Considerations in Case Hardening Steel by Nitriding (De teoritiska och praktiska förutsättningarna för ythärdning av stal genom nitrering). Gunnar Hägg. *Jernkontorets Annaler,* Vol. 115, May 1931, pages 183-207.

The equilibrium diagram of the systems Fe-N, its modifications in the presence of other metals and the mechanism of nitriding by NH_3 are discussed on the basis of the author's X-ray investigations (*Zeitschrift für physikalische Chemie,* 8, 1930, page 455; *Nature,* Vol. 121, 1928, page 826; Vol. 122, 1928, pages 314, 962). With the exception of Al, all metals present in nitriding steels are transition elements, the nitrides of which have a metallic character. No nitrides of Co and Ni are known, but all other transition elements used in alloy steels have a higher affinity for N than Fe, and accelerate the nitridation. This is even more true of Al. AlN, as such, is not present since Al is dissolved in the FeN. Al, Cr and Mo all suppress the γ-phase but probably do not influence the homogeneity range of the ϵ-phase to any appreciable extent. Suppression of the γ-phase is probably beneficial. A survey of the literature on the practical application of nitriding is given. HCD (10c)

Some Unusual Metallurgical Applications and Uses of Fused Salt Baths. Wm. J. Merten. *Fuels & Furnaces,* Vol. 9, Jan. 1931, pages 51-52.

The decomposition of the nitrides in cyanided parts and in arc-welded parts; blueing steel surfaces to prevent corrosion; obtaining maximum use of a metal—all by means of fused salt baths—are discussed. High temperature salt baths are also considered. Ha (10c)

Carburization of Steel with Gas. R. G. Guthrie (Peoples Gas Light & Coke Co.). *Metal Progress,* Vol. 20, Nov. 1931, pages 50-54.

The author presents reasons for the selection of gas as a carburizing medium. The presence of a sub-oxide of iron to prevent the deposition of soot is secured by proper control of the water content of the gas. The intermittent surge method of introduction of the gas is discussed as a means of controlling the case characteristics. WLC (10c)

Continuous Nitriding Process will Produce any Degree of Penetration of Hardness by Varying the Heat Cycle. R. J. Cowan (Surface Combustion Corp.). *Automotive Industries,* Vol. 65, Aug. 1931, pages 314-318.

Arrangements of successive temperature zones that may be easily controlled makes it possible to obtain different types of cases at will. Illustration of continuous nitriding furnace, together with 7 charts showing various dissociation effects, are given. A summary shows: (1) batch-type process cannot produce satisfactory work with an ammonia dissociation greater than 50%, which is due to high H concentration causing excessive decarburization: (2) continuous nitriding, where the ammonia moves along in the muffle in the same direction as the work, the danger of high H is eliminated; (3) by this process, it is possible to use fully all of ammonia admitted to system; (4) total time reduced by 1/3; (5) consumption of ammonia greatly reduced. DTR (10c)

Quenching (10d)

Dimensional Stability of Heat-Treated Aluminum Alloys. *Fuels & Furnaces,* Vol. 9, Apr. 1931, pages 433-434.

Serious dimensional changes which occur when machining operations are carried out on material quenched in cold water are reduced to relatively small proportions in "Y" alloy and duralumin by the use of boiling water as quenching medium. These alloys develop satisfactory mechanical properties when quenched in boiling water. On the other hand, they are more easily corroded than when quenched in a more vigorous medium. Ha (10d)

Drawing (10e)

Modern Rod Baking. R. S. Coulter. *Wire & Wire Products,* Vol. 6, Aug. 1931, pages 321-323.

An improved method of rod baking is described by the use of forced ventilation and a re-circulation air system. The overall thermal efficiency is 27%. In the case described, fuel costs and production were considerably improved. Ha (10e)

Aging (10f)

Duralumin. *Metallurgist,* Jan. 1931, pages 12-13.

The age hardening which is the characteristic feature of duralumin and of a number of other alloys of similar type requires a previous heat treatment which is frequently termed the "solution" treatment, since the object is to bring certain constituents of the alloy—more especially the Cu and Mg-Si compounds—as far as possible into solid solution. This treatment must be followed by quenching, usually in cold water. In the case of Y-alloy, which is used mostly for castings, quenching in hot water is used. Quenching in hot water, however, seems to render the alloy subject to intercrystalline corrosion. It is suggested that the explanation is the condition of the surface, whether under compression, free of stress, or under tension. If the latter, intercrystalline corrosion will result. The results reported by L. Pessel in *Heat Treating & Forging* of Nov. 1930 are of particular interest. He applied a salt spray corrosion test to the surface of the metal and after 30 days he could determine whether the material had been quenched in hot or cold water, the former showing a greater rate of corrosion. From the photographs given, the author draws conclusions contradictory to those of Pessel and concludes that the question must be investigated further before his results can be accepted. If Pessel's results are correct, then liability to intercrystalline attack is not in itself the determining factor in the indications of surface corrosion as revealed by the appearance of the specimens which have been exposed to the salt spray. VVK (10f)

Age-Hardening in Aluminium Alloys. *Metallurgist,* Feb. 1931, pages 30-32.

A critical review of the work of Kokubo and Honda (*Science Reports, Tohoku Imperial University,* Vol. 19, No. 4, 1930, page 366) on the mechanism of the age-hardening of Al alloys containing from 0 to 12% Cu. The criticism of the author is that the heat treatment used was unsuitable for the purpose and that the conclusions arrived at as original are practically identical with those of Gayler and Preston (*Journal Institute of Metals,* Vol. 41, 1929, page 191). VVK (10f)

Pressure-Ageing of Duralumin. *Metallurgist,* Sept. 1930, pages 136-137.

A review of the work of L. Pessel in *Industrial & Engineering Chemistry* for July 1930. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 177. VVK (10f)

The Course of Aging of a Few Aluminum Sand-Cast Alloys. (Ueber den Verlauf der Alterung bei einigen Aluminum-Sand-guss-Legierungen.) W. Saran. *Zeitschrift für Metallkunde,* Vol. 23, Jan. 1931, pages 32-33.

The aging of 3 Al alloys is studied by means of the elastic limit (0.01 or 0.03%) and Brinell hardness. The first alloy contained 9.7% Zn, 2.1% Cu, 1.28% Fe, 0.25% Si, 0.23% Mg; the second an (American) alloy with higher (but unstated) Zn content and with 8% Cu, 0.2% "Y," Fe and Si normal; the third an alloy with 15% Zn, 2% Cu, 0.22% "Y," Fe and Si normal. The first alloy was sand (10-11% moisture) cast from 680° C., and annealed at 490° C. and quenched in water. A curve of the variation in Brinell hardness with time at room temperature is given. This shows a maximum at 12 days, a following minimum and then a slow increase with time. The points scatter showing a certain periodicity which may be related to the night-day temperature change. The second and third alloys were also sand (6% moisture) cast and the aging followed by Brinell hardness and elastic limit. The elastic limit increases about 1.7 kg./mm.^{2} after 21 days for both alloys; the Brinell hardness shows only a slight increase. Because of the special addition "Y," it is not necessary to heat-treat the alloy after casting in order to induce aging. The aging of these 2 alloys is approximately proportional to the time. RFM (10f)

JOINING OF METALS & ALLOYS (11)

Soldering, Brazing and Riveting Sheet Metals. Part III. Riveting. *Sheet Metal Industries,* Vol. 4, Oct. 1930, pages 447-449; Nov. 1930, pages 541-547.

The applications of riveting, the types of rivets used, the types of joints, the methods of finishing rivets and the proportioning of riveted joints is discussed. Tables for single-riveted and double-riveted lap joints give proper rivet diameters, lap, pitch, and percentage of strength for riveted joints in sheet metal work up to ⅛ in. thickness. Riveting of Al is discussed briefly. The capabilities of 2 riveting machines are set forth—they are the Hann riveting machine and a small, high speed hammer. AWM (11)

Brazing (11a)

Silver Brazing of Monel Metal and Nickel. *Inco,* Vol. 10, No. 4, 1931, pages 26-27.

Ag solders are alloys of Ag, Cu and Zn with or without other metals in small amounts. The main characteristics of Ag solders are: melting points from 1325°-1600° F.; free flowing (they penetrate almost instantly); joints have a tensile strength of 40,000 to 60,000 lbs./in.^{2}; almost unlimited corrosion resistance; neat joints. Instructions for the use of Ag solders and fluxes for it as well as the precautions necessary are given. Ha (11a)

Making Joints with Electric Brazing Tongs. *Machinery,* Vol. 38, Sept. 1931, pages 23-24.

A little brazing transformer to heat the ends can be used for joining Cu, Ni, Ag, steel and their alloys. 3 different Ag fluxes with melting points of 1337°, 1355° and 1526° F. are used. Ha (11a)

Silver Brazing of Monel Metal and Nickel. *American Metal Market,* Vol. 38, Apr. 2, 1931, pages 3, 5.

Includes discussion. Gives definite details and characteristics of silver solders. Composition, penetration, strength, ductility, corrosion resistance. Expert directions for brazing include cleaning, fitting, fluxing, preheating and soldering. Also typical applications. DTR (11a)

Brazing Alloy with Low M. P. *Brass World,* Vol. 27, Aug. 1931, page 186.

"Sil-Fos" is an alloy containing a small proportion of Ag and flowing freely at 1300° F. It has free flowing properties with deep and quick penetration. It is manufactured by Handy & Harman, N. Y. C. "Sil-Fos" may be used for joining brass, bronze, nickel, nickel-silver, extruded brass and bronze, monel metal and other metals and alloys fusing above 1300° F. WHB (11a)

Welding & Cutting (11c)

Investigations on the Gas Fusion Weldability of Chrome Molybdenum Alloy Steels for the Construction of Aeroplanes (Untersuchungen über die Gasschmelzschweissbarkeit von chrommolybdänlegierten Stählen für den Flugzeugbau). K. L. Zeyen. *Krupp'sche Monatshefte,* Vol. 12, Aug.-Sept. 1931, pages 214-223.

After a review of the literature on chrome-molybdenum alloy steels for aeroplanes, the results of experiments made on thin sheets of such steels with different welding wires are described. Instead of the American steel (SAE No. 4130 with 0.25-0.35% C and 0.8-1.1% Cr), it seems more advisable to use a steel with less C (0.2-0.25%) and a higher Cr content (1.3-1.5%) to obtain a better weldability with increased hardness. The unalloyed welding wires gave, in all cases, lower values of strength. Ha (11c)

The Gas Supply of Welding Shops (Aus der Praxis der Gasversorgung von Schweisswerkstätten). From the experimental laboratory of the Autogen Works. E. Zorn. *Autogene Metallbearbeitung,* Vol. 24, July 15, 1931, pages 207-215.

A survey of the means and arrangements for the storage of carbide the storage of acetylene, and pipe lines for acetylene. A special chapter treats of acetylene in flasks for which the manufacturers prescribe definite rules. The containers and reduction valves for the compressed O are also discussed and practical suggestions are given. Ha (11c)

Arc Welding. E. J. Tangerman. *American Machinist,* Vol. 75, July 2, 1931, pages 2-6.

The technique, equipment and effect of arc welding, both manual and automatic, of machine structures is discussed at length. Ha (11c)

Automatic Oxy-Acetylene Cutting in Machine Building. D. E. Roberts. *Machinery,* Vol. 37, Nov. 1930, pages 161-164.

Demonstration of the application of machines having automatically guided blowpipes which cut steel billets and plates to shape in any thickness up to 15 ins. Ha (11c)

The Influence of Small Additions to the Weld Rods on the Welding of Copper. (Ueber den Einfluss von geringen Zusetzmengen in den Schweissdrähten auf die Schweissung des Kupfers.) W. Geldbach. *Autogene Metallbearbeitung,* Vol. 24, Nov. 1, 1931, pages 319-331; Nov. 15, 1931, pages 335-345.

A systematic and comparative investigation on the influence of additions of P, Al, Be, Mg, Li, Ti, V, Si, Mn, Cr, Zn, Cd, Ni, Sb, As and Ag in the welding wires on the weldability and fluidity of Cu was made. The "fluidity" is defined by the physical properties of the melt, in particular by the surface tension and viscosity. 2 principal types are found: (1) very mobile fluidity (produced, for instance, by the addition of P) and, (2) viscous fluidity, for instance, wires containing Al. Fluidity of type (1) was obtained by wires containing high percentages of P and Li. Type (1a) was obtained by Ti, Sb, As, Zn, Ni, Ag. Type (2) was obtained by Be, Al, Mg, Si, Mn, Cr and Cd. Type (1a) was produced by a suitable flux —usually containing boric acid (B_2O_3)—to type (2). The tests are described at great length. For details, the paper must be consulted. 60 references. Ha (11c)

Steel Carpentry. C. M. Taylor. *American Machinist,* Vol. 75, Sept. 3, 1931, pages 378-379.

Illustrations of welded structures which formerly were made by castings, wood or other building-up processes. Ha (11c)

Arc Welding in Japan. M. Taylor. *American Machinist,* Vol. 75, Oct. 22, 1931, pages 68-639.

Description of methods, mainly obsolete, which are in use. Very wide use of welding is, however, noted. Ha (11c)

Construction Engineer Discusses Structural Welding. Harry E. Stitt (Austin Co.). *Iron Age,* Vol. 128, Sept. 24, 1931, pages 812-814.

Welding offers possibilities of overcoming many shop and field difficulties. Describes welding equipment of the Austin Co. In conclusion, the author sums up the advantages of welding. VSP (11c)

Welded Pipe Construction in Steel Structures. R. Ulbricht. *Engineering Progress,* Vol. 12, Oct. 1931, pages 224-226.

See "Welded Pipe Joints in Steel Architecture," *Metals & Alloys,* Vol. 2, Nov. 1931, page 267. Ha (11c)

CO_2 Plant Manufactured by Welding in Melbourne. *Welder,* Vol. 2, Aug. 1931, pages 15-18; Vol. 3, Sept. 1931, pages 25-28.

The chimney 50 ft. long, 3 ft. in diameter was welded in 3 sections of 5/16 in. and 1/4 in. plate; weight 215 tons. Absorber towers and heaters, gas tank of 10 ft. diameter and 9 ft. deep were also welded. Ha (11c)

Arc-Welding of Locomotive Frames. J. M. Vossler. *Welding,* Vol. 2, July 1931, pages 446-447; Aug. 1931, pages 511-513.

Autogenous welding in boiler repairs, locomotive cylinders, reclamation of car parts, reclamation of superheater units and boiler flues, arc welders' tools and oxy-acetylene welders' service trucks are discussed and described. Some suggestions as to preparation and procedure are given. Ha (11c)

Welding in the Piping Industry. John Zink. *Industry & Welding,* Vol. 2, Oct. 1931, pages 10-13.

General remarks on joining pipes by welding, the factors of design and cost estimating, workmanship. All of these contribute, both technically and commercially, to success. Ha (11c)

Fusion Welding Specifications for Steel and Wrought Iron Pipes. John H. Zink. *Welding,* Vol. 1, Dec. 1930, pages 975-978.

The fusion welding specifications adopted by the Heating & Piping Contractors Association are complete as to workmanship, design and materials. Discussion and illustrations are included. Ha (11c)

Testing Welded Construction during Production. *Chemical & Metallurgical Engineering,* Vol. 37, Oct. 1930, pages 609-610.

Deals with procedure at the Barberton, Ohio Works of the Babcock & Wilcox Company. Contains same information as "Develops New Technique in Electric Arc Welding," by J. D. Knox in *Steel,* Vol. 87, Oct. 9, 1930, pages 64-65. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 181. MS (11c)

Review of Welding Methods and the Testing of Welded Seams with Special Consideration of Welding in Boiler Making (Uebersicht über die Schweissverfahren und die Prüfung der Schweissnähte mit besonderer Berücksichtigung der Schweissung im Dampfkesselbau). K. L. Zeyen. *Krupp'sche Monatshefte,* Vol. 12, June 1931, pages 121-139.

A comprehensive survey of the various methods of pressure welding and fusion welding, of which only the latter is of im portance in steam welding; i. e. gas welding and electric arc-welding. The weldability of the steel and the influence on it of the composition, the polarity of the zones with explanatory photomicrographs, costs for gas and electric welding as function of the thickness of the boiler plate, testing methods of samples and of the finished pieces and testing apparatus are discussed at great length. 23 references. Ha (11c)

Welding in the Locomotive Boiler. James M. Vossler. *Welding,* Vol. 2, Oct. 1931, pages 679-681; Nov. 1931, pages 731-733, 743-744.

Success of metallic arc welding of firebox sheets depends on proper preparation of edges, cleaning preparatory to welding, and proper welding procedure to take care of expansion and contraction. Angle of opening for butt welds should be between 75° and 90°. Opening at the apex of the Vee should be 3/32-1/8". The step-back method should be followed in welding. A modified double Vee joint is recommended and illustrated. Ha+TEJ (11c)

Tests of Welds. Wilbur M. Wilson. *University of Illinois Engineering Experiment Station Circular* No. 21, Nov. 1930, 37 pages; *Canadian Engineer,* Vol. 59, Sept. 16, 1930, page 332.

The investigation pertains only to hand-welding of the relatively thin steel plates used in the fabrication of storage tanks for oil and water systems. The objects of the investigation were to determine the physical properties of a weld-rod after it had been deposited in a weld, the relative merits of various types of welds for thin plates, and the relative merits of various types of weld-rods. Of the welds tested, the V type seems to be the best for making butt-joints in ½-in. plates. In the study of various types of weld-rods, 36 specimens were tested that had been welded by the same workman, a journey-man welder employed by the Chicago Bridge and Iron Works; 6 specimens were made from each of 11 kinds of rods. The weakest specimen developed 46,000 lbs./in.^{2} The lowest average for any one set of 6 specimens made from the same kind of rod was 50,500 lbs./in.^{2} The specimens received no heat treatment after the welds were made. Specimens made from rods designed to produce a reducing atmosphere over the molten metal had a strength of an average of 60,000 lbs./in.^{2} The data indicate that a rod designed to produce a reducing atmosphere over the molten metal may be, but is not necessarily, superior to an uncoated rod. The strength of welded specimens made from uncoated rods was 57,500 lbs./in.^{2} when the beads were laid longitudinally with the specimens, and 43,300 lbs./in.^{2} when the beads were laid tranversely to the specimens. VVK+WAT (11c)

Welding with Atomic Hydrogen. J. F. SPRINGER. *Modern Machine Shop,* Vol. 4, Nov. 1931, pages 30-36, 73.

The principle and the action of atomic hydrogen welding is described, i. e., the breaking up of ordinary H by the electric arc into atomic hydrogen which combines again at a nearby point and creates a flame of about 4000° C. Because of its protection against outside contamination, very ductile welds are produced. Steel as well as aluminum can be welded. A number of applications are described and illustrated. Ha (11c)

Replacement of Castings with Welded Steel Plate. G. D. SPACKMAN. *Welding,* Vol. 2, Oct. 1931, pages 673-674.

Because it is homogeneous, uniform ,and its properties known, steel properly made, rolled, cut, formed and welded, is superior in the construction of machinery and equipment parts. TEJ (11c)

Welding Research. H. L. WHITTEMORE. *Industry & Welding,* Vol. 2, Oct. 1931, pages 7-9, 23.

General remarks on the way in which practical research should be carried out. The most important feature is to invariably keep complete records of whatever has been done. Ha (11c)

Arc-Welding the Stainless Alloys. V. W. WHITMER. *Welding,* Vol. 2, July 1931, pages 457-464.

The expansion, fixtures and electrodes and the characteristics of alloy chrome-nickel steels in welding are discussed and illustrated in micrograms. The physical properties of the steels Enduro AA and KA2S are given in a table. Methods of testing and test results are explained and illustrated. For welding these alloys, a coated rod is recommended. Ha (11c)

Factors Affecting the Weldability of Steel. W. E. STINE. *Journal American Welding Society,* Vol. 10, Sept. 1931, pages 22-26; *Electrical World,* Vol. 98, Oct. 26, 1931, pages 786-788.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Investigation of causes of slag holes and gas holes in arc welds. Aluminum oxide, or any other non-metallic inclusion in steel which has its melting point between the melting point and boiling point of steel, will cause slag holes or pits in the weld metal of electric arc welded steel unless it is fluxed with some other material which lowers its freezing point below that of steel. Al, Si, Mn or any other deoxidizers having gas solvent properties, which are present in excess of the quantity necessary for chemical equilibrium with the O present in the steel at a temperature slightly above the temperature of solidification, may cause the formation of gas holes in the weld metal of electric arc welded steel. Curves are reproduced which indicate Al, Si and Mn content of steel of optimum arc welding characteristics. 7 references are given. TEJ+WHB (11c)

Automatic Carbon-Arc Welding (Selbsttätige Kohle-Lichtbogenschweissung). S. SANDELOWSKY. *A. E. G. Mitteilungen,* Nov. 1931, pages 656-663.

The carbon-arc welding differs from metal wire arc welding principally in that the sheets to be welded are joined with as little additional material as possible merely by welding the edges together (butt welding). The carbon arc is, therefore, usually used for edge welding; several methods are illustrated. An automatic welding machine for this purpose has been developed which is described fully and curves taken from tests made on sample rods of different thicknesses are reproduced. The advantages of this simpler procedure which does not require as elaborate preparations as metal arc welding are noted. Ha (11c)

Electrically Welded Steel Water Pipe. W. H. POWELL. *Canadian Engineer,* Vol. 59, Nov. 4, 1930, pages 599-604.

50,000 ft. of electrically-welded pipe were furnished the Greater Vancouver Water District in 1929 and 1930. The details of its manufacture, testing and suggestions for shop practice are given. VVK (11c)

Welding Structural Steel Buildings. FRANK P. MCKIBBEN. *Canadian Engineer,* Vol. 61, July 14, 1931, pages 15-18, 52.

The details of the erection of the 19-story, all-welded office building of the Dallas Power & Light Co., Dallas, Texas, are given, including the qualifications and requirements of welders. VVK (11c)

Jigs of Arc-Welded Steel. H. F. KNEEN (Lincoln Electric Co.). *American Machinist,* Vol. 74, Apr. 30, 1931, page 689.

Largely pictorial. Gives a few suggestions as to jigs which can be arc-welded. RHP (11c)

Flame-Cuts in Spring Steel (Brennschnitte an Federstahl). ALEX. MATTING. *Autogene Metallbearbeitung,* Vol. 24, Sept. 15, 1931, pages 277-280.

Numerous tables and microphotographs of etching illustrate the tests made on hardened and unhardened spring steels by manual and by machine cutting with a flame. An influence can be seen clearly; but a subsequent heating or hardening removes this influence. The zone in which an influence can be found does not need to be removed as long as the cutting edges are not subject to particular stresses. Machine cutting proved to be more advantageous than manual cutting. Ha (11c)

Welding Solves Another Problem. FRANK P. MCKIBBEN. *Journal American Welding Society,* Vol. 10, Sept. 1931, pages 47-49.

Paper presented before the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Description of a unique remodeling problem which consisted of the transference of a large load from an existing main building column to a new girder, removal of the lower story's length of column, the abatement of noise and avoiding subsidence of existing construction. TEJ (11c)

Electric Welded Steel Floor Construction. LEE H. MILLER. *Canadian Engineer,* Vol. 58, June 24, 1930, pages 701-702.

A paper presented before the American Welding Society. See *Metals & Alloys,* Vol. 1, Oct. 1930, page 801. VVK (11c)

Welded Buildings and Bridges Erected in the United States. FRANK P. MCKIBBEN. *Welding,* Vol. 2, Sept. 1931, pages 612-618.

A list of 46 partially or wholly welded bridges and 183 partially or wholly welded buildings in the United States. TEJ (11c)

The Manufacture of Machine Parts for Aviation Viewed from Safety Standpoint. (Le faconnage des éléments de machines de la construction aéronautoque considére au point de vue de la sécurité.) J. Androuin. *Revue de Métallurgie*, Vol. 28, Oct. 1931, pages 575-580.

Attention is called to the proper care to be exercised in finishing parts and their jointing so as to prevent localized stresses. Hand work must be eliminated as far as possible. JDG (11c)

Welded Boiler. J. C. Hodge. *Boiler Maker*, Vol. 31, Jan. 1931, pages 2-8.

Fusion-welded seams have been accepted for 24 boilers for new scout cruisers of the U. S. Navy. Tests of sample welds are described and macrographs and micrographs show conditions of the weld which are acceptable and those which are not acceptable. The physical and chemical welding characteristics specified by the Navy and as obtained by Babcock & Wilcox are tabulated. Ha (11c)

Welding Allegheny Metal. G. Van Dyke. *Machinery*, Vol. 37, July 1931, pages 875-877; *Sheet Metal Worker*, Vol. 22, Aug. 21, 1931, pages 497-498.

Allegheny metal is a chrome-nickel iron alloy containing approximately 18% Cr, 8% Ni and small amounts of Mn and Si. The C in this alloy will vary from 0.15 to 0.06%, depending upon the class of work for which it is to be used, and the method employed in fabricating it. This particular type of alloy lends itself readily to welding by the electric, gas or spot processes. The 18-8 type of stainless steel finds wide application not only because of its weldability, but also because it presents great resistance to a large variety of corrosive attacks. The first consideration in gas-welding Allegheny metal is to get the proper mixture of acetylene and O. If an excess of O is used, it will burn up or oxidize a considerable portion of the Cr, and this not only changes the analysis of the metal, but also produces oxides of Cr which will cause the metal to boil and result in welds that are porous and of low corrosion resistance value. If an excess of acetylene is used, the molten metal will absorb a certain amount of gas, and the C content of the weld will thereby be raised. This increase in C content is very detrimental to the corrosion resistance and produces a brittle weld. Evidently an exactly neutral flame with an excess neither of acetylene nor oxygen would be desirable and, if it were possible to produce such a flame, it would probably be ideal. The flame should be adjusted so as to give a very slight excess of acetylene. In gas-welding this alloy, the torch should be held as close to the metal as possible, so as to push the flame down into the weld; and the rod would be held above the weld so that it will melt and drop down as the welding proceeds. Puddling should be avoided, as it tends to produce a porous weld. Ha (11c)

Arc Welding Everdur. T. E. Jerabek. *Boiler Maker*, Vol. 31, Mar. 1931, pages 68-69.

Everdur, a Cu-Si-Mn alloy with qualities equal to steel and able to resist corrosion and chemical action, can be arc-welded. A metallic electrode ⅛ to 3/16 in. thick of similar composition to the parent metal is used with a current of 90-160 amp. The arc must be held somewhat longer than is common in the arc-welding of rolled steel. Micrographs illustrate the quality of the welds which are made. Ha (11c)

Development in Arc Welding Methods. *Canadian Engineer*, Vol. 59, July 22, 1930, pages 169-170.

Late developments in arc welding are reviewed. The advantages of welding for machinery design and building construction are enumerated. VVK (11c)

Fusion Welding as Applied to Pressure Vessels. *Boiler Maker*, Vol. 31, Sept. 1931, pages 242-244.

The Chicago, Burlington & Quincy Railroad decided to use welded construction because of the high maintenance cost of riveted seams on their tie-treating retorts. Ha (11c)

Oxwelding for Overland Pipe Lines. *Canadian Engineer*, Vol. 59, Nov. 25, 1930, pages 661-666.

Taken from *Oxy-Acetylene Tips*. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. VVK (11c)

Graphic Formula Finds Proper Welding Steel. *Welding*, Vol. 2, June 1931, page 394.

An equilibrium diagram was developed by Wm. Stine of the Lincoln Electric Co., Cleveland from an investigation of the causes of the difference (sometimes inexplainable) in 2 similar welds. It is seen from this diagram that, for a certain percentage of C, the amount of Si and Mn and, eventually, Al can be taken to obtain the correct proportion of elements in steel for welding. Ha (11c)

Metallic-Arc Method of Pipe Making. *Iron & Coal Trades Review*, Vol. 123, Oct. 16, 1931, pages 573-574.

Description of an automatic welding machine installed at the South Durham Steel & Iron Co., England. It can accomodate 30 ft. pipes and tanks 9 ft. high. Ha (11c)

Electric Welding Steel Tubing. *Boiler Maker*, Vol. 31, Mar. 1931, page 71.

The Johnson process and equipment used by the Steel & Tubes Inc., Cleveland, is described. Tubing up to ¼ in. thick can be welded. The process consists of feeding large coils of flat steel stock into the forming rolls to be formed cold into a tube. This passes directly under the electrodes where fusion takes place without the addition of foreign materials at a speed of approximately 80 ft. of tubing/min. The welding burr is eliminated and the weld is almost imperceptible. When operated at full capacity, over 1200 kilowatts are concentrated continuously in a spot not larger than the eraser on a pencil. Ha (11c)

Proposed Specifications for Fusion Welding *Boiler Maker*, Vol. 31, Mar. 1931, pages 79-80, 84.

Reprint of revisions of the Boiler Code Committee. Ha (11c)

Gas Welding of Alloys. *Welding*, Vol. 2, June 1931, pages 372-376.

Procedure-control methods used for oxy-acetylene process of welding ferrous and non-ferrous metals are described briefly and illustrated. The particular precautions necessary in using some materials are pointed out. Ha (11c)

Electric Welded Steel Pipe Lines. F. W. Hanna (Chief Engineer, East Bay Municipal Utility District, Oakland, Calif.). *Journal American Water Works Association*, Vol. 23, June 1931, pages 785-792.

A detailed description of the electric welded Mokelumne pipe line comprising 58.6 miles of 65", 13.9 miles of 63", 9.1 miles of 61" and 1.1 miles of 54" internal diameter pipe made of steel plates of ⅜, 7/16, and ½" thicknesses. VVK (11c)

Automatic Welding Thin Walled Cylinders. W. A. Maddocks. *Welding*, Vol. 2, Nov. 1931, page 744.

By swiftly flattening the cylinder previous to welding by an attachment to the automatic welder, the cylinder assumes its true shape after the metal has cooled. Ha (11c)

Arc-Welding a Steel Factory Building. H. B. Hanna. *Canadian Engineer*, Vol. 59, Dec. 23, 1930, pages 727-730.

A detailed description of the all-welded construction of the switchboard building of the Peterborough plant of the Canadian General Electric Co., Ltd. VVK (11c)

Autogenous Welding of Lead and its Alloys—Ancient and Modern. E. B. Partington. *Welding Engineer*, Vol. 28, Oct. 1931, pages 304-310.

Paper read before the members of the Institute of Welding Engineers, Oct. 15, 1931. The author gives a brief history of the early manufacture of lead from the ore, its uses and characteristics. Various methods of lead-burning are described and their relative merits discussed. Physical properties and welding qualities of some alloys of lead with Cd, Sb and Sn are mentioned. The author enumerates various lead-burning applications and gives data on gas consumption. TEJ (11c)

Investigations of Electric Arc Welding with Metallic Electrodes (Untersuchungen über die elektrische Lichtbogenschweissung mit metallischen Elektroden). *Die Schmelzschweissung*, Vol. 9, Sept. 1930, page 201.

Tests were made with iron electrodes covered with a mixture of graphite and carborundum in varying amounts and steel sheets welded with them. The welds were then analyzed chemically and the hardness tested. Pure graphite cover and the one with 90% graphite gave the best hardness, Brinell 420, with a minimum hardness of 145 at 40% graphite, rising again to 250 at pure carborundum. With an addition of barium carbonate of 1%, it was not necessary to preheat, but the welding took a little longer when connected to the negative pole. Ha (11c)

Arcogen, a New Combined Autogenous-Electric Welding Process (Arcogen, ein neues kombiniertes autogen-elektrisches Schweissverfahren). *Automobil-technische Zeitschrift*, Vol. 34, Sept. 10, 1931, page 557.

A short description of this new method of the I. G. Farbenindustrie A.G. which has been treated more in detail in *Metals & Alloys*, Vol. 2, Mar. 1931, page 70. Ha (11c)

New Pipe Mills at McKeesport Works of National Tube Co. Sidney G. Koon. *Iron Age*, Vol. 127, May 7, 1931, pages 1502-1507.

Describes the new electrical welding pipe department. This plant makes pipes from steel plates in lengths of about 40 ft. Electric welding is done in a battery of 30 machines. Capacity is about 4 miles of pipe/day. VSP (11c)

The Theory of Welding Stresses (Etwas über die Theorie der Schweisspannungen). *Schmelzschweissung*, Vol. 10, Sept. 1931, pages 223-226.

Theoretical treatment of determining the stresses in different kinds of welds. Ha (11c)

The Future of Welding in the Aircraft Industry. *Welding*, Vol. 2, Sept. 1931, pages 605-607.

The aircraft industry now thinks in terms of welding. This is due to the success attained in the past few years with various kinds of welded structures. This writer states that oxy-acetylene welding has been given preference because it is more universally adaptable to the fabrication of the several types of approved aircraft joints. Manufacturers of gas welding equipment, therefore, have been active in developing light weight, reliable and efficient equipment for the airplane factory. This writer also claims that it is generally conceded that a longer training period is required, therefore causing fewer operators to qualify than in the case of the arc welding process. He concludes, however, that the development of apparatus which will permit easier and better control of the arc probably will lead to more extensive applications of this arc method to aircraft work in the future. Ha (11c)

Welding Automobile Wheels. C. L. Eksergian. *American Machinist*, Vol. 75, Sept. 17, 1931, pages 459-463.

As a process in the manufacture of automobile wheels, welding has made considerable gains. However, with the exception of one wire wheel in which the spokes are welded, it only has been at a relatively recent date that welding has been utilized to any extent. The fact that welding has proven itself to be perfectly dependable even though subjected to the high loads carried by wheels at last has won the confidence of the dubious. This fact, together with the manufacturing economies effected, has justified its pioneers and will serve, no doubt, to widen its adoption. Perhaps the most widely used types of welding in wheel practice are the flash or the butt weld. Practically all rims and felloe bands employ circling. This practice has been in effect for a great number of years, hence welding of that character may be regarded as being quite orthodox. Although the terms "flash" and "butt" welding are often interchanged, actually these 2 forms of welding possess distinct characteristics and function of operation. It so happens, however, that in many instances the actual welding operation amounts to a compromise between a true butt and a true flash method. For this mixed form of welding either term is probably equally appropriate. Ha (11c)

Welding Practice in Tramway Concerns. *Welder*, Vol. 3, Oct. 1931, pages 4-7.

Repair of parts of equipment and rails is described. Ha (11c)

Welding of Lead not Difficult. *Sheet Metal Worker*, Vol. 22, Oct. 30, 1931, pages 621-622.

Some practical suggestions are given for the use of the blow pipe for gas welding of Pb. Ha (11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

The Diminishing of Non-Metallic Inclusions in Steel by Adding Zirconium (Die Verminderung nichtmetallischer Einschlüsse im Stahl durch Zirkonzusatz). W. Zieler. *Archiv für Eisenhüttenwesen,* Vol. 5, Sept. 1931, pages 167-172.

The paper deals first with a paper by A. L. Field, *Transactions American Institute Mining & Metallurgical Engineers,* Vol. 69, 1923, pages 848-894, on the effect of Zr upon the contents of O, Ni and S in steel. The second part gives the results of the author's own investigations on a Cr-Mo steel, the charges of which had in part been treated with Zr-Si. The effect of Zr was studied by counting the inclusions in polished specimens taken from various parts of the rolled billets. Since Zr has a stronger deoxidizing effect than Si and eliminates the dangerous effect of S by the formation of ZrS, it essentially decreases the non-metallic inclusions of steel. The production costs of steel do not increase very much by the addition of Zr. GN (12a)

Open Hearth Furnace Practice (La pratica del Forno Martin). F. Fiorelli. *La Metallurgia Italiana,* Vol. 23, Oct. 1931, pages 955-963.

By sketches, the furnace ports and gas circulatory systems of several types of open hearth furnaces, including the Terni furnace, are described. HWG (12a)

Characteristics of Rimmed Steel. E. C. Bitzer. *Blast Furnace & Steel Plant,* Vol. 19, Feb. 1931, pages 249-251; Mar. 1931, pages 415-417, 422.

Rimmed steel is called a product of the basic open-hearth and acid Bessemer processes and is a steel partially deoxidized, either in the furnace or in the ladle, and poured in this condition. The predominant reaction goes on between dissolved ferrous oxide and C as follows: $FeO + Fe_3C \rightleftharpoons 4\,Fe + CO$. The range of analysis of this steel is usually 0.02-0.20% C, 0.15-0.50% Mn, 0.025-0.050% S, any desired amount of P and a trace of Si. The production and treatment is described in detail. A list of references is added. Ha (12a)

Fluorspar in the Open-Hearth Slag. H. L. Geiger. *Blast Furnace & Steel Plant,* Vol. 19, Mar. 1931, pages 412-414.

The formation of silicate, phosphate and tapping slags is explained. The investigation shows that no fluorspar, but iron oxide is the actual thinning agent of the slag; the fluorspar acts only indirectly as the medium for setting up an unstable condition of the slag which can only be neutralized by the addition of iron oxide obtained from the bath. 9 references. Ha (12a)

Steelmakers Face New Era of Steel Cleanliness. *Steel,* Vol. 88, Jan. 1, 1931, page 290.

The deoxidation of steel with Mn-Si alloys, the mechanical control of combustion and the study of the influence of slag composition promise to produce steel of exceptional cleanliness. The application of the electrolytic method for extracting non-metallic inclusions from steel offers a rapid and economical means for determining the number, volume and character of the impurities present. Also, quick analytical methods are now available for determining the physical properties of slags during the workdown of open-hearth heats. JN (12a)

Aluminum Melting Furnace of Large Capacity Fired by Solid Fuel. Rob. J. Anderson. *Fuels & Furnaces,* Vol. 9, May 1931, pages 583-586, 618; June 1931, pages 697-700; July 1931, pages 799-802; Aug. 1931, pages 933-936.

The article describes and gives the design of an aluminum melting furnace of the open flame stationary hearth type which is fired by coal or coke. This type is used for a number of melting operations, of scrap, melting, remelting, alloys for casting, etc. They range from 2000 to 50,000 lbs. The use of coke is said to give a better quality of metal as the quantity of gas taken into solution by the metal is considerably less when melted in an open flame, coke fired furnace. The technique of handling large quantities of liquid Al metal and methods and equipment in foundry and rolling mill are discussed at length. Ha (12a)

The Use of Strontianite in Basic Open Hearth Furnaces (Emploi de la strontianite dans le four Martin Siemens basique). *Journal du Four Electrique,* Vol. 40, Mar. 1931, page 96.

The addition of mineral strontianite to the slag of hot working basic open hearth furnace is claimed to reduce the S content of the metal to ½ provided the original content of it is high enough to give in the final product not less than 0.03% S. JDG (12a)

The Deoxidation of Copper. *Metallurgist,* Dec. 1930, pages 182-183.

The work of Schumacher, Ellis and Eckel (*American Institute Mining & Metallurgical Engineers Technical Publication* No. 240) on the use of Ca as a deoxidizer for Cu and (*Metals & Alloys,* Vol. 1, Sept. 1930) the use of Zn, Be, Ba, Sr and Li for the same purpose is reviewed with the following comment. "In considering these results from a quantitative standpoint, it must be borne in mind that the published data apply only under the conditions of melting employed by the authors, since the oxidation of the metal and consequently the amount of deoxidiser added will vary with the melting and casting conditions, and if certain precautions are used to limit oxidation as far as possible, the quantity of deoxidiser to be added will of necessity be smaller. Recent research has also pointed out that it is possible for oxygen to co-exist in copper with a deoxidising element such as phosphorus, and that in all probability an equilibrium is set up between oxygen and the deoxidising element, so that the ultimate concentration of the reacting elements will depend on various conditions such as time of reaction and their initial concentration. The results are complicated by the fact that the copper is continually absorbing oxygen to an extent depending on the nature of the surrounding atmosphere, and on the precautions, if any, taken to exclude that element. The application of the quantitative results must, therefore, be confined to the particular conditions under which the data were obtained." VVK (12a)

Casting & Solidification (12b)

The Solidification and Crystallization of Steel Ingots: The Influence of the Casting Temperature and the Undercooling Capacity of the Steel. Bernhard Matuschka. *Iron & Steel Institute, Advance Copy* No. 12, Sept. 1931, 16 pages.

Discusses the mechanism of solidification. The external conditions are governed by the rate of heat extraction by the mold. The internal conditions are set by the nature of the alloy being cast. The course of solidification was studied by dumping the molten alloy from a mold after it had remained in the mold for a given length of time. Macrographs of etched and of fractured sections illustrate the effects of different casting conditions on the primary structure. The factors that govern columnar crystallization are discussed in detail. JLG (12b)

Permanent Mold Casting of Aluminum Alloys. J. B. Nealey. *Machinery,* Vol. 37, Oct. 1930, pages 100-102.

The advantages of using permanent molds rather than sand castings or die-castings are: a wider range of alloys can be used as pouring is done by gravity and higher temperatures can be used, as is required by metals melting in the neighborhood of 2000° F. The physical properties of permanent mold castings and the alloys used for them, the materials used for permanent molds, construction of melting furnaces and annealing and finishing methods are discussed in general. Ha (12b)

Die Castings may Now be made of Brass. L. H. Morin (Doehler Die Casting Co.). *Iron Age,* Vol. 127, May 7, 1931, pages 1522-1523.

The commercial production of brass die castings embraces the following conditions: (1) handling of the metal at the lowest possible temperature and (2) the removal of the finished casting from the die in the shortest possible time. VSP (12b)

Casting Guns by the Centrifugal Process. T. C. Dickson. *Iron Age,* Vol. 127, June 4, 1931, pages 1816-1818.

Taken from a paper read before the American Society for Steel Treating. Includes part of discussion. Describes method of procedure and gives the metallurgical advantages obtained. Shows how a moderate segregation in the resultant material is of benefit in meeting service requirements. See also *Metals & Alloys,* Vol. 2, Nov. 1931, page 269. VSP (12b)

Casting under Pressure (La coulée sous pression). *Revue Fonderie Moderne,* Vol. 25, July 25, 1931, pages 273-275.

A brief discussion and description of the principles, the most suitable metals (alloys of Sn-Pb, Zn, Al and, lately, brasses) and their economic advantages. Most advantageous thicknesses for die casting are 0.75-2.5 mm. for the Sn-Pb alloys; 1.5-2.5 mm. for Zn alloys; 2-3.5 mm. for Al alloys. Corners and angles should be avoided. They should be rounded off by a radius of at least 0.5-1 mm. Suggestions for the best arrangements of the metal molds are given. Ha (12b)

Pouring Practice for Avoidance of Defects in Aluminum Ingots for Rolling. G. L. Craig (Battelle Memorial Institute). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 192-196.

2 references. The author describes several defects in aluminum sheet and states that the more difficult to control, slivers, are due to non-metallics or spongy metal in the ingot. The author describes a method of slow casting in a slowly rotating chill mold. The metal is poured with ladle very close to the mold which is at a slight angle from the horizontal and, as the mold fills, the mold is slowly turned until it finally assumes a vertical position where the slow pouring is continued to feed the pipe. This method of pouring eliminates segregation of inclusions and limits the spongy portion to the very top of the ingot. WLC (12b)

Die Casting of Brass. (La coulée sous pression du laiton.) Lebruly. *Revue Fonderie Moderne,* Vol. 25, Sept. 10, 1931, pages 331-333.

Description of molds, mode of operation and a machine. Ha (12b)

112-Ton Ingot Mould. *Engineering,* Vol. 131, Mar. 6, 1931, page 339.

An illustration is given of mold made by the Brightside Foundry & Engineering Company, Ltd. Ingots larger than any ever before produced in England can be made in this mold. Ingots will be used to produce heavy rotors, hollow forgings for high-pressure chemical vessels, etc. It is being used at the Vickers works of the English Steel Corporation, Ltd. LFM (12b)

Alloy Steel Guns Cast Centrifugally with Mounts of Welded Parts. *Iron Age,* Vol. 125, May 22, 1930, pages 1521-1522.

The process of centrifugally casting guns permits a more rapid manufacture and a superior product. The material is a Mo steel of 0.35-0.4% C and about 0.4% Mo. After casting, the one-piece muzzle is subjected to a cold-working process by hydraulic pressure up to 120,000 lbs./in.^{2} by which the elastic limit of the steel is increased. The mount is made entirely of welded parts. For melting the material, a high-frequency electric furnace was used. The largest gun made in this way weighed about 8000 lbs. Ha (12b)

Liquid Metal is Pressure-Cast into Steel Dies. *Foundry,* Vol. 59, Jan. 1, 1931, pages 75-78.

After some historical remarks on die-casting, methods for die-casting in machines are described and some installations and their operation are illustrated. Ha (12b)

Steel Casting Pattern Allowances for Contraction or Shrinkage and for Machine Finish. *Research Group News,* Vol. 8, Oct. 1931, pages 424-428.

General discussion of the manner in which these allowances should be determined. Ha (12b)

Best Pouring Temperature for Babbitt. Correspondence from James Brinn, Chicago, Ill. *Metals & Alloys,* Vol. 2, Oct. 1931, page 180.

The casting temperatures for babbitt bearings are discussed in the light of the effect of grain size on the wearing characteristics. WLC (12b)

Casting Pipe Centrifugally. S. B. Clark. *American Machinist,* Vol. 75, July 30, 1931, pages 201-203.

The de Lavaud process is described. By it, pipe is cast centrifugally. Molten iron is introduced into a cylindrical metal mold inclined slightly to the horizontal, completely enveloped by hot water and rotating at a comparatively high velocity. Iron is fed into the mold through a trough with a curved spout at its lower end. The stream of iron discharging from the spout flows tangentially to the surface of the mold where it is held in place by centrifugal force thus forming a homogeneous pipe; the pipe is later annealed at 1700° F. 10 pipes of 6-10 in. in diameter and 10 ft. long could be produced hourly in a machine which is described in detail. The microstructure of such pipe is much more uniform and finer grained than sand cast pipe and has a tensile strength of 30-35,000 lbs./in.^{2}, a modulus of rupture of 50-60,000, a modulus of elasticity of 10-13,000,000 and a Shore hardness of 30. Larger machines are now being built. Ha (12b)

Superheating of Crystal Nuclei (Das Problem der Ueberhitzbarkeit von Kristallkeimen). R. Bloch, T. Brings & W. Kuhn (Technische Hochschule Karlsruhe). *Zeitschrift für physikalische Chemie,* Sect. B, Vol. 12, June 1931, pages 415-426.

The melting process is considered as a surface phenomenon. Although thermo-dynamically less stable, small crystals exist for a longer time in a melt than larger ones. Large, slightly damaged crystals dissolve rapidly at the broken boundary surfaces, but the smaller ones require a heat of activation to dissolve off the undamaged surfaces resulting in a slower rate of melting. Fluctuations in the life time of crystal nuclei are calculated. The fluctuations amount to about 10% of the life time at the beginning of the crystallisation process and for nuclei of ordinary size. EF (12b)

Rolling (12c)

Advantages of Twin-Motor Drive for Rolling Mills. R. H. Wright & H. E. Stokes (Westinghouse Elec. & Mfg. Co.) *Iron Age,* Vol. 128, July 2, 1931, pages 12-14, 20.

From a paper read before the Association of Iron & Steel Electrical Engineers in Cleveland. The principle advantages of twin-motor drive for reversing service are: (1) motor capacity applied to a single pair of rolls is greatly increased; (2) pinion losses, repairs and maintenance are eliminated; (3) motors may be designed to have greatly reduced inertia; (4) roll chatter and spindle vibrations are eliminated; (5) higher rolling speeds are maintained and tonnage is increased. VSP (12c)

New Designs of Rolling Mill Bearings. H. Weinlig. *Blast Furnace & Steel Plant,* Vol. 19, Mar. 1931, pages 402-405; Apr. 1931, pages 551-552.

The latest German practice of using all-wood bearings with forced lubrication is described and examples are illustrated. See *Metals & Alloys,* May 1931, page 106. Ha (12c)

Machining (12g)

The Elements of Metal Cutting. Orlan W. Boston. *Engineering Research Bulletin* No. 5, *Department of Engineering Research University of Michigan,* Ann Arbor, Dec. 1926, pages 1-95.

This paper gives an account of an investigation in the fundamental elements of metal cutting. The object was to determine a relation between the force on the tool in the direction of the cut for a constant cutting speed of 20 ft./min. and the degrees of sharpness, the various tool angles, width and depth of cut and the physical properties of the materials cut. The latter consisted of 3 C steels, 3 alloy steels, brass and annealed and unannealed cast iron. The cutting was confined to straight-line motion on a planer. The tools used were of the end-cutting type. No cutting fluids were used and but one element was varied at a time. The results show that the clearance angle has no influence on the force. Thick chips are removed more efficiently than thin chips and narrow chips more efficiently than wide chips. All tests and their results are given in detail and a number of appendices for recording tests and a bibliography supplement the paper. Ha. (12g)

Expansion Fits with Liquid Air. E. V. David & W. S. Farr. *Power,* Vol. 74, Oct. 6, 1931, pages 506-507.

The pin, shaft, bushing, etc., are machined to a diameter slightly larger than the hole to be fitted, cooled in liquid air, placed in hole and heated to room temperature. AHE (12g)

The Progression of Commercial Accuracy—Turning, Grinding, Lapping. *Grits & Grinds,* Vol. 22, Feb. 1931, pages 1-10.

A brief historical sketch of the development of the 3 processes, of which lapping is the most delicate, to obtain the highest degree of accuracy. Fields for its use, hand lapping and machine lapping are discussed and a list of machine parts with their successful application is added. Ha. (12g)

Drawing and Stamping (12h)

Stretcher Strains Depend Upon Speed of Draw. Joseph Winlock & A. E. Lavergne (Edw. G. Budd Mfg. Co.) *Metal Progress,* Vol. 20, Sept. 1931, pages 90-93.

Authors present a study of the effect of speed of working on the appearance of stretcher strains, "worms" or lines of Luder in deep drawn articles. Previous treatment as to speed of drawing or heat treatment are shown to influence the appearance or non-appearance of such strain markings. The study of the effect of previous treatment suggests methods of avoiding these strains. WLC (12h)

Forming Properties of Thin Brass Sheets. W. A. Straw, M. D. Helfrick & C. R. Fischrupp. *Metal Stampings,* Vol. 4, Mar. 1931, pages 247-248; *American Machinist,* Vol. 74, Apr. 9, 1931, page 593.

Abstract of a paper presented at the New York Meeting of the American Institute of Mining and Metallurgical Engineers, week of Feb. 16, 1931. See *Metals & Alloys,* Vol. 2, July 1931, page 136. RHP & JN (12h)

Lubrication and Application of Tungsten-Carbide Dies. C. R. Longwell. *Wire & Wire Products,* Vol. 6, Oct. 1931, pages 391-392, 411.

The author notes the extreme pressures a lubricant has to stand in wire drawing. It should be applied directly before the die to give best results. The question of lubricants for wire drawing has not yet been solved satisfactorily. The possibility of hot drawing to almost the right size and then making the last passes cold is discussed briefly. Ha. (12h)

Construction and Uses of Typical Dies, Part IV. Edward Heller. *Metal Stampings,* Vol. 4, Apr. 1931, pages 341-342, 350.

Discusses construction features and applications of an adjustable type of die which severs blanks from a strip instead of cutting around the blanks, a general utility die for notching square corners and a piercing die for a wide range of shapes and sizes of holes. MS (12h)

Factors Affecting Wire Drawing and Methods of Doing It. R. R. Tatnall. *Iron Age,* Vol. 127, Feb. 19, 1931, pages 629-631.

The mechanics of wire drawing is briefly explained. Wire is drawn for 3 purposes: to shape the metal into a convenient form, to obtain a desired size and to give increased strength to it. Some of the limitations of this process and the means of overcoming are discussed. Only a certain reduction can be made at a single draft; after a certain number of successive drafts, an intermediate annealing is required. As long as the metal is not abused, the structure is improved to a considerable degree by drawing. Ha. (12h)

Carboloy Dies. *Carboloy,* Vol. 3, Nov. 1930, pages 14-15.

Tungsten carbide is particularly fitted for dies for drawing bars, tubes and wires on account of its almost diamond-like hardness. In one mill, for example, where a 0.191 die was employed, the average wear after 300 t. of wire was 0.001 for each 99 t. of wire drawn. The question of lubricant is not yet sufficiently solved. Ha. (12h)

Experiments in Wire Drawing: Part I. Behaviour of the Composite Rod. Alkins & Cartwright. *Engineer,* Vol. 152, Oct. 2, 1931, pages 358-359.

Abstract of paper read before the Institute of Metals, Zurich, Switzerland, Sept. 15, 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 272. LFM (12h)

Refinements in Die Practice. C. V. Dorer. *American Machinist,* Vol. 75, Aug. 6, 1931, pages 233-235.

Discussion of the economical considerations which determine the number and arrangement of dies in quantity and job production. Ha. (12h)

Pressed Metal Work in Making Radio Parts. W. T. Fulton (Surface Combustion Co.). *Iron Age,* Vol. 127, May 7, 1931, pages 1519-1521, 1554.

Describes the metal forming and heat treating appliances at the Stromberg Carlson Telephone Mfg. Co.'s plant at Rochester, N. Y. The metal forming section is equipped with automatic screw machines for various parts. The heat treating furnaces are fired by gas. Low pressure system is used for air regulation. See also "Stamping Equipment Employed in Radio Manufacturing," *Metals & Alloys,* Vol. 2, Nov. 1931, page 272. VSP (12h)

Failures of Railway Materials, Dealing Chiefly with Ferrous Metals. E. A. Wraight & P. Hinde. Government of India Central Publication Branch, Calcutta, 1930. Paper, 6¼x9¾, 61 pages. Price 5s 3d.

Deals with examination of a few failed materials. The preface remarks, "It is surprising, in spite of the knowledge on the subject, how sharp corners persist in manufactured parts, and it seems necessary still to stress the necessity for avoidance of these." Rails, axles, tires, and miscellaneous materials are dealt with briefly. Many of the failures were due to incorrect design or lack of proper care in service, but some axles were supplied without the heat-treatment required by specification and failed due to faulty material.

Failures in wrought iron draw bar hooks were traced to low grade iron in some cases and in others to forging so that the slag lines ran at right angles to the direction of the applied load. The hooks are now being made of 0.35% C steel and failures are rare. Only a few cases of rail failure were examined. These were chiefly due to laps and to secondary pipe in big-end down ingots. H. W. Gillett (13)-B-

Steel Contamination from Stopper Heads. Rich. H. Stone. *Blast Furnace & Steel Plant,* Vol. 19, Feb. 1931, page 278.

As the author estimates that 90% of silicate contamination of ingots are due to stopper heads made of refractories, he advocates the use of a graphite head on the stopper. Ha. (13)

Hair-Line Cracks. T. M. Service. *Iron & Coal Trades Review,* Vol. 122, Feb. 27, 1931, pages 358-359.

The author reviews past literature on the origin of this defect and comes to the conclusion, on the basis of his own experiments, that the defects known as hair-line cracks are due to stress produced as the result of differential cooling. See *Metals & Alloys,* Vol. 2, July 1931, page 136. Ha. (13)

Oxides in Alloy Steels. *Metallurgist,* Jan. 1931, pages 14-15.

In an earlier paper Wasmuht and Oberhoffer (*Archiv für Eisenhüttenwesen,* Vol. 2, 1928-29, pages 829-842) investigated the use of Cl gas as a medium for the decomposition and separation of the metallic portion from the oxygen carriers for carbon, silicon, and manganese steels. In a recent paper Wasmuht (*Archiv für Eisenhüttenwesen,* Sept. 1930, pages 155-159) has extended this investigation to alloy steels. The method depends on the complete decomposition of the alloy and the carbides which are present by Cl gas at temperatures at which the oxides are not attacked. The pure alloying metal, its alloys with iron and the carbides were individually tested as to the possibility of decomposition by chlorine at increasing temperatures. Similarly, the resistance of the oxides to attack by Cl was examined. The experiments were also repeated with the addition of C. Pure Cr metal was first attacked at 400° C. and completely decomposed at 700° C. When alloyed with Fe, the attack commenced at lower temperatures in proportion to the decrease in the percentage of Cr and with an alloy containing 15% Cr complete decomposition occurred at 500° C. The decomposition of chromium carbide begins at 300° C. and is complete at 500° C. Chromium oxide is attacked at about 500° C. to some extent and above 500° C. the attack is stronger in the presence of C. The estimation of chromium oxide in chrome steel by decomposition in Cl gas at 500° C. is, therefore, promising. The decomposition of metallic W commences at 300° C. but the rate is slow up to 500° C. and then increases rapidly to above 700° C. Fe-W alloys are attacked just above 100° C. and the rate of attack increases rapidly up to 300° C. Between 300° and 500° C. the attack is somewhat retarded, possibly owing to the presence of carbide, but decomposition is complete about 700° C. Tungsten carbide is resistant to attack; decomposition commences above 300° C. but at 800° C. is still very incomplete. The oxide is slowly attacked above 500° C. but afterwards more rapidly. In the presence of C it is strongly attacked at about 400° C. Tungsten oxide cannot, therefore, be determined by the Cl method. Metallic Mo is approximately, and ferro-molybdenum completely, attacked at 300° C. The decomposition of the carbide commences at 300° C. but is still incomplete at 400° C. The oxide is slowly attacked at about 300° C. but quite strongly between 500° and 600° C. In the presence of C, the attack sets in earlier and is more complete. It is therefore clear that owing to the relative stability of the carbide, the method is not available for the estimation of oxide, especially as the carbide and oxide cannot be simply and accurately separated in the residue. Ni is attacked by Cl at about 300° C. but as the chloride only begins to volatilize at 500° C. washing out with water is necessary. Nickel steels are attacked at 300° and decomposition is complete at 500° C. and as nickel carbide is not usually present in steel it need not be considered. However, as nickel oxide is very unstable in Cl gas, being strongly attacked at 200° C. and completely decomposed at 700° C. the method was not further investigated. The behavior of Co is very similar to that of Ni. The method of determining chromium oxide in chrome steels was worked out as follows. The decomposition temperature employed was 500° C. and the chromium chloride formed was dissolved in warm water containing stannous chloride. Filtering and washing was carried out on a membrane filter. The silica was estimated by evaporation with hydrofluoric acid, the residue was fused with bisulphate and the Cr in the solution of the melt was estimated by the ferrous sulphate method. The amount of oxide was obtained by calculation from the percentage of Cr. VVK (13)

Mottled Tin Plates. *Iron & Coal Trades Review,* Vol. 123, Oct. 16, 1931, pages 578-579.

The question of whether Bessemer steel or open hearth steel is preferable for tin plate and if the rolling has some effect is discussed. With regard to the flux used, the time of contact or immersion in the tin seems to be of importance, also. This phase of the tinning process has not been thoroughly investigated so far. Ha. (13)

Use of Heat-Resisting Steel in the Determination of Nitrogen by the Jaeger Method. W. Zwieg. *Gas- und Wasserfach,* Vol. 74, June 13, 1931, page 576; reviewed in *Gas Journal,* Vol. 195, July 8, 1931, page 85.

Combustion tubes made from Krupp's NCT_3 steel (supplied by Mannesmann Tube Company) offer many advantages over silica tubes which suffer from a tendency towards devitrification and are ruined if caustic potash solution is allowed to enter them. The metal tubes, which are cheaper in replacement costs over a period, have a higher thermal conductivity than have the silica tubes and are thus brought up to temperature more quickly. The copper oxide may be regenerated in the normal manner, and the ends of the tubes may readily be kept cool by use of wet wicks. MAB (14)

The Detection of Cobalt as Cesium Cobaltinitrites. Note by Herman Yagoda & H. M. Partridge. *Journal American Chemical Society,* Vol. 52, Dec. 1930, pages 4857-4858.

Procedure is as follows: The mixture of cobalt and nickel sulphides from the usual procedure is dissolved in aqua regia and evaporated just to dryness. Residue is dissolved in 1 or 2 cc. of 6 M acetic acid. To this solution 2 cc. of 6 M sodium nitrite and 0.5 cc. of 0.5 M cesium nitrate (or 0.25 M cesium sulfate suggested as a reagent for aluminum) are added and the yellow $Cs_2NaCo\ (NO_2)_6$ precipitates. MEH (14)

The Application of the Potentiometric Volumetric Analysis in the Steel Mill Laboratory. Part II. A General Method for the Determination of Vanadium (Die Anwendung der Potentiometrischen Massanalyse im Eisenhüttenlaboratorium. II. Eine allgemein anwendbare Schnellbestimmung des Vanadins). G. Thanheiser & P. Dickens. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, No. 15, 1931, pages 187-191; *Archiv für Eisenhüttenwesen,* Vol. 5, Aug. 1931, pages 105-110.

Report 85. The cold reduction of permanganate by tartaric acid and the manner in which this titration is effected by $MnSO_4$ is described and a rapid method for determining V has been developed. The new method gives reliable results and is always applicable. GN (14)

Determination of Chromium and Vanadium in Ores and Alloys after Oxidation with Perchloric Acid. Hobert H. Willard & R. C. Gibson. *Industrial & Engineering Chemistry,* Analytical Edition, Vol. 3, Jan. 15, 1931, pages 88-93.

Presented before the Division of Physical and Inorganic Chemistry at the Minneapolis meeting of the American Chemical Society September 1929. 17 references. Cr and V may be completely oxidized to chromic and vanadic acids by boiling with 70% perchloric acid, the oxidizing action of which is removed by dilution with water, after which any of the usual titration methods may be used. Mn is not oxidized. Directions are given for applying the process to the analysis of chromic oxide, chromite, steel, and ferrochromium. MEH (14)

Gravimetric and Direct Volumetric Determination of Cadmium. R. C. Wiley. *Industrial & Engineering Chemistry,* Analytical Edition, Vol. 3, Jan. 15, 1931, pages 14-15.

Cd may be determined by precipitating as cadmium molybdate and weighing as such. It may be determined also volumetrically by titrating with a standard ammonium molybdate solution, using a saturated solution of pyrogallol in chloroform as indicator. MEH (14)

The Iodide Method for Copper. Bartholow Park. *Industrial & Engineering Chemistry,* Analytical Edition, Vol. 3, Jan. 15, 1931, pages 77-82.

25 references. A short and accurate method for determining Cu in ores, slags, mattes, etc., has been developed and the effect of pH value and of the presence of other metals has been investigated. MEH (14)

Foundation and Methods of Chemical Analysis by the Emission Spectrum. Translation of "Die Chemische Emissionsspektralanalyse" by Walther Gerlock and Eugene Schweitzer. Adam Hilger, Ltd., London, 1931. Cloth, 6¼x10 inches, 123 pages.

This attractively printed booklet presents the author's reasons for expecting spectrographic analysis to come into wider use and, in considerable detail, the methods used in this laboratory as well as other current technique. They prefer spark-spectra to arc and claim the 4 following advantages for spectrographic analysis over ordinary chemical analysis: "expedition, the possibility of analysis of minute quantities of material, the entire preservation of the available material, and the facility of ascertaining the distribution of an element in a given substance."

The subject matter is divided into 7 chapters including theoretical aspects, discussion of equipment, qualitative and quantitative analysis, refinements by photometric measurements and special problems. The book is entirely free from any advertising for the publishers and is well worth while for the prospective user of spectrographic equipment as well as those directing analytical work. C. P. Larrabee (14)-B-

Separation and Gravimetric Determination of Osmium. *Journal Franklin Institute,* Vol. 211, Mar. 1931, pages 374-375.

Brief description of very accurate method for determining Os. At a pH of 4.0, Os is completely precipitated as hydrated osmium dioxide, which coagulates well and settles quickly. Filtered on a Gooch or Monroe crucible, washed with hot 1% NH_4Cl, moistened with a strong solution of NH_4Cl, heated and reduced in a H atmosphere, cooled in H and finally CO_2, and then weighed as metal. DTR (14)

Investigations on Helium. X. on a Method for the Determination of Minute Quantities of Radium (Heliumuntersuchungen. X. Über eine Methode zur Messung kleinster Radiummengen). F. Paneth & W. Koeck (University of Königsberg). *Zeitschrift für physikalische Chemie, Bodenstein Festband,* 1931, pages 145-151.

A method has been developed for the determination of radium emanation down to 10^{-13} Curie with an accuracy of 20%. The utilization for geological age determinations is set forth. See *Metals & Alloys,* Vol. 2, Oct. 1931, page 230. EF (14)

HISTORICAL & BIOGRAPHICAL (15)

Development of the Modern Blast Furnace. Geo. E. Rose. *Blast Furnace & Steel Plant,* Vol. 19, Feb. 1931, pages 255-257.
An historical sketch of the successive changes of lines and dimensions from 1880 to the present-day furnaces of large capacity. Ha. (15)

The Ancient Egyptians had Hardened Steel. Henry D. Hibbard. *American Machinist,* Vol. 74, Apr. 16, 1931, pages 602-605.
The ancients had Au, Ag, Hg and bronze but none of these would have been hard enough to do the work which was done. If stone tools had been used, some of the worn tools should remain. Wrought iron free of C has a higher melting point than the ancients could obtain; by adding C, they could melt it and make steel. Some of the statuary contains marks of cutting that indicate very hard tools. Worn steel tools are not found because they were remelted for other uses. RHP (15)

The Ancient Egyptians had Stone, not Steel. E. J. Tangerman. *American Machinist,* Vol. 74, Apr. 23, 1931, pages 654-657.
A rebuttal of the articles entitled "The Ancient Egyptians had Hardened Steel" by Henry D. Hibbard. Claims that the Egyptians did their work with stone and abrasives—not steel. RHP (15)

Prehistoric Iron Plants in the Siegerland (Vorgeschichtliche Eisenschmelzen im Siegerland). O. Krasa, *Stahl und Eisen,* Vol. 51, Oct. 15, 1931, pages 1287-1289.
The results of recent excavations in the oldest iron ore mining district of Germany give some insight into construction and method of operation of those old hearth furnaces for processing iron. Some analyses on slags and lumps are given. Documents prove that the first blast furnaces with water driven blowers were known in that district around 1300. GN (15)

Evolution of Malleable in France (L'evolution de la malléable en France). R. Gailly. *Congress International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 871-873.
A general and brief survey. Cites unsuccessful efforts to improve malleable by addition of Ni. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 316. HWG (15)

85-Year-Old Cast Iron Pipe Still in Use in Boston. *Water Works Engineering,* Vol. 84, Oct. 7, 1931, page 1430.
Length exposed of line installed in Boston Common in 1846. Pipe was manufactured in Scotland. CBJ (15)

Famous Men of Carron. *Foundry Trade Journal,* Vol. 45, Aug. 13, 1931, page 104.
A brief reference to the work of Major-General Henry Shrapnel, the inventor of the shell which bears his name. The first shrapnel shells were manufactured at the Carron works, and some interesting references to the early accounts in this connection are made in this brief article. OWE (15)

Ten Years of Research for the Metal Industries. A Review of the work of the B. N. F. M. R. A. *Metal Industry,* London, Vol. 39, July 19, 1931, pages 37-38.
Mention is made of all the work of the British Non-Ferrous Metals Research Association. PRK (15)

Ancient Greek Iron. William Campbell (Columbia University) & Ernest E. Thum. *Metal Progress,* Vol. 20, Nov. 1931, pages 43-49.
The authors report a metallographic examination of ancient specimens of Athenian iron made about 425 B.C. WLC (15)

The Tin Industry; the Development of Tin-Mining. *Tin,* July 1931, pages 5-9.
A brief story of history and present status and methods of tin mining in England. Ha. (15)

Rolling Steel Today is a Science. W. H. Melaney. *Blast Furnace & Steel Plant,* Vol. 19, Jan. 1931, pages 105-107.
Impressions of a thoroughly experienced engineer with regard to the practice of former days and those of today. Ha. (15)

ECONOMIC (16)

Zinc Metallurgy in 1930. J. A. Singmaster. *Mining & Metallurgy,* Vol. 12, Jan. 1931, pages 30-31.
This review finds that flexible smelting processes capable of producing special products or recovering valuable by-products are more important than small cost reductions in standard processes. Ha (16)

The Basic Bessemer Process: Some Considerations of its Possibilities in England. V. Harbord. *Engineer,* Vol. 151, May 22, 1931, pages 565-566.
Abstract of paper read before the Iron & Steel Institute May 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 275. LFM (16)

Production Economy in Iron and Steel Works. Part II.—Costs of Production. O. Cromberg. *Iron & Steel Institute, Advance Copy* No. 6, Sept. 1931, 26 pages.
A discussion of cost accounting in metallurgical works. The advantages of time studies and piece work rates are stressed. Examples for determining costs in typical operations are given. JLG (16)

Canadian Plants Combat Steel Mill Problems. *Iron & Steel of Canada,* Vol. 14, Aug. 1931, pages 130-132.
A description of the difficulties under which Canadian plants have to function and of the products which Canadian steel mills undertake to make, which serve to indicate the complexity of the steel business as conducted in the Dominion. OWE (16)

Present Position and Development of the Japanese Steel Industry. H. Yoshikawa. *Proceedings World Engineering Congress,* Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy,* Part 1, pages 163-211.
In Japanese. A one-page English list of subjects dealt with is given but the actual information in the paper is not summarized. HWG (16)

A Glance at the Italian Metallurgical Industry (Prospettive dell' Industria Siderugica Italiana). L. Norsa. *Metallurgia Italiana,* Vol. 23, Oct. 1931, pages 897-908.
General and statistical. 12% of the steel production of Italy is from the electric furnace. HWG (16)

Economic Planning in the Mineral Industry. Thos. T. Read. *Mining & Metallurgy,* Vol. 12, Sept. 1931, pages 406-409.
Discussion of some of the social and business problems as well as the technical problems involved. Ha (16)

Changing Sources of Metals. W. A. Scheuch. *Mining & Metallurgy,* Vol. 12, July 1931, pages 322-323.
The author notes that secondary sources of metals have become so important as to justify well designed and carefully located units capable of producing high quality products. Some statistics prove this, particularly for Cu and Pb the quantities of which, available from secondary sources in the U. S., amount to more annually than the primary Cu produced by Arizona and the primary Pb produced by Missouri. Ha (16)

Point System for Determining Molding Rate and Costs. W. J. McNeill (Federal Malleable Co.). *Iron Age,* Vol. 128, Sept. 3, 1931, pages 614-615.
Abstract of a paper read before the American Foundrymen's Association. The system consists of assigning values to each part of the mold making operations, values being expressed in points. The sum of the points represents the total value of the various operations, but does not express it as the price of the mold. To convert the total points into the price/100 molds, the total must be multiplied by the hourly earning coefficient. To the resulting figure is added the pouring, which is paid for at the rate of 10c/cwt. of casting weight/100 molds. This system has been used by the Federal Malleable Co. since 1922. VSP (16)

Is Silver a Commodity? Tsuyee Pei. *Mining & Metallurgy,* Vol. 12, Feb. 1931, pages 86-88.
The use and value of silver as a monetary basis and its national-economical importance in international relations is discussed. It is not considered a commodity in countries that are on a silver basis, but as the standard value of currency. Ha (16)

Variations in Yield Exert Great Influence on Brass Foundry Costs. J. B. Meier. *Foundry,* Vol. 59, Feb. 15, 1931, pages 43-46.
Tables are compiled showing the change of profits with varying numbers of workers, varying output/man, varying yield and because of defective castings. Ha (16)

Steel Consumption in the United States and Germany. A. Michels. *Iron Age,* Vol. 128, July 16, 1931, page 176-179, 208.
The per capita consumption of steel for the 2 countries is compared. Only in the item of bars has the German per capita consumption approached that of the United States closely and surpassed it in 2 yrs. The American consumption of tinplate is about 6 times that of Germany. The distribution of steel orders to private enterprises and the government show, for the latter, a very large percentage in Germany. For details, the paper must be consulted. Ha (16)

Accounting with Sliding Cost Factors in Foundries. (Das Rechnen mit gleitenden Unkostensätzen in Giessereibetrieben.) H. Jordan. *Archiv für Eisenhüttenwesen,* Vol. 5, Oct. 1931, pages 219-222.
Report 52 of the Committee on Plant Efficiency of the Verein deutscher Eisenhüttenleute. The author makes some suggestions as to better accounting in foundries, and deals with the advantages which his proposals offer in comparison with the methods used at present by German foundries. GN(16)

Scrap Conserving the Nation's Iron Ore Resources; Large Tonnages Added Yearly to Record of Lake Reserves. A. J. Hain. *Steel,* Vol. 88, Jan. 1, 1931, pages 262-265.
The life of the higher grade iron ore deposits in the Lake Superior district is estimated at 20 to 25 yrs. This figure disregards the ever increasing use of scrap by steelmakers. Better methods of reclaiming scrap and wider use of it in iron and steel manufacture will greatly extend the above estimate. During 1920-1929, scrap iron consumption increased 61%, while iron ore consumption increased only 9.9%. There was an average annual decline of 40 lbs. of ore consumed/ton of iron and steel produced. Some open-hearth producers report as high as 55% of scrap in their annual output. In 1929, the iron and steel industry used over 30 million tons of scrap, representing over 43% of its total output. This resulted in conserving over 20,750,000 tons of ore. The tax records of Minnesota and Michigan show reserves of ore sufficient for more than 27 yrs. JN (16)

PLANTS & LABORATORIES (17)

Electrical Equipment for Steel Mills. H. A. Winne. *Blast Furnace & Steel Plant,* Vol. 19, Jan. 1931, pages 109-110.
Description of some new large motor installations with auxiliary equipment made in 1930. Ha (18)

Melt Aluminum in Electrically Heated Pot Furnaces. W. S. Scott. *Foundry,* Vol. 59 Oct. 1, 1931, pages 67-68.
Describes an installation of 2 furnaces of 200 lbs. of molten Al/hr., each. The operating costs total $.586/100 lbs. Ha (17)

India's Only Copper Producer—The Indian Copper Corporation. Russell B. Woakes, *Engineering & Mining Journal,* July 27, 1931, pages 51-53.
A description. Flowsheets are shown for the concentrator, the smelter and the pulverized coal plant. WHB (17)

Plate Mill of the Gulf States Steel Co. W. Worthington. *Blast Furnace & Steel Plant,* Vol. 18, Nov. 1930, pages 1709-1710.
Brief discussion of a 32 in. universal plate mill with auxiliary equipment. Ha (17)

Heat Treating Parts in Automobile Fan Manufacture. H. M. Heyn (Surface Combustion Co.). *Iron Age,* Vol. 128, Sept. 3, 1931, pages 616-619.
Describes the plant of the Automotive Fan & Bearing Co., Jackson, Mich. The principle kind of fan made is a plain bearing with lubricating pump in the fan hub. In the heat treating room, 40 x 40 ft., there are 2 furnaces, one of which is used for carburizing. It is of the counter flow type. Gas is used for heating. It uses 447 ft.^{3} of 530 B.t.u. gas/hr., heating 285 lbs. of work to 1650° F. The other furnace is of the V-notch pusher type used for hardening; it heats 200 lbs. of work/hr. to 1500° F., using 252 ft.^{3} of 530 B.t.u. gas. VSP (17)

MACHINERY & SUPPLIES (18)

Steel-Mill Tonnage Increased by Twin-Motor Roll Drives. H. H. WRIGHT & H. E. STOKES (Westinghouse Elec. & Mfg. Co.). *Electric World,* Vol. 98, July 25, 1931, pages 164-166.

The recently developed twin-drive for reversing mills, in which each of the mill rolls is driven by an individual motor has five conspicuous advantages over the common single-motor drive: (1) the motor capacity applicable to a single roll is greatly increased, (2) pinion losses, repairs and maintenance are eliminated, (3) the motors may be designed to have greatly reduced inertia, resulting in less strain on the equipment, more torque available for useful work, reduced motor and generator heating and faster acceleration, (4) roll chatter and spindle vibration are practically eliminated, (5) higher rolling speeds can be maintained and mill tonnage can be increased. WHB (18)

Devices for Conveying Steel Sheets. FRANK M. FISH. *Blast Furnace & Steel Plant,* Vol. 18, Aug., 1930, pages 1329-1333.

Deals with transportation of sheets from the mill to the railroad cars by means of conveyors, power trucks and hand operated trucks. MS (18)

Crane Equipment in Foundries. *Foundry Trade Journal,* Vol. 45, Sept. 3, 1931, page 152.

After classifying electric handling apparatus into 2 broad classes, intermittent and continuous, the author deals with various types of crane in some detail and then turns his attention to the electrical equipment with which cranes are ordinarily supplied. The various factors which must be considered when installing electrically operated travelling cranes are dealt with. OWE (18)

A New Centrifugal-Casting Machine. *Foundry Trade Journal,* Vol. 45, July 23, 1931, page 51.

A description of a machine for the manufacture of gear wheels, rings, etc., which has been successfully used in the production of ferrous and non-ferrous castings up to 3 ft. in diameter or more. The machine, which is produced by Messrs. Craven Brothers (Manchester), Limited, of Reddish, Stockport, England, is shown in sectional elevation; a photograph of the machine also accompanies the article. OWE (18)

The Revolver Core-Making Machine. *Foundry Trade Journal,* Vol. 45, July 16, 1931, page 45.

A description of a core-making machine utilizing the principle of forcing the sand into a core box by means of compressed air operating at 60-85 lb./in.^{2} The paper is accompanied by 4 photographs and 2 diagrams, showing the plan and the elevation of the machine, respectively. OWE (18)

Machine for Rolling Heavy Metal Forms. *Iron Age,* Vol. 126, July 31, 1930, page 299.

Describes machines for forming heavy sheet metal into window framing, cornice molding and door butts. VSP (18)

Molding Cores by Compressed Air. *Engineering Progress,* Vol. 12, May, 1931, pages 110-111.

Detailed description of a foundry core revolver, a core-making machine produced by the Albertus Werke, Hanover, Germany. Ha. (18)

A Large Rolling-Mill Drive. *Electrical Review,* Vol. 108, Mar. 13, 1931, page 464.

Description of the equipment and control of 12,000 hp. DC motor for a 27 in., 3-stand reversing mill for 30/70 r.p.m. maximum speed 110 r.p.m. It is supplied by a motor-generator fly wheel set running at 600 r.p.m.; the weight of the fly wheel is 21 tons, weight of the mill motor, 114 tons. Ha. (18)

Modern Electric Welders. *Electrical Review,* Vol. 108, Mar. 20, 1931, pages 506-507.

Brief description of characteristic performances of welding-transformers and welding dynamos of British manufacture. Ha. (18)

Quick Work Shear for Cutting Circles in Steel Plate. *Boiler Maker,* Vol. 31, Sept., 1931, pages 249-250.

A large shear for cutting plates up to 72 ins. in diameter is described. The shearing speed is about 40 lineal ft./min. An average of 750 pieces can be cut in 11 hrs. The operation costs $3.45/hr., of which $2.70 is for labor and $0.75, for roughing out the plates. Ha. (18)

Compressed Air for Forge Hammers. *Heat Treating & Forging,* Vol. 16, Aug., 1930, pages 985-988.

Notes the advantages of air over steam for operating forging hammers and describes a few installations. Ha. (18)

MISCELLANEOUS (20)

Copper-Oxide Rectifiers. KARTAR SINGH. *Electrical Review,* Vol. 109, Aug. 14, 1931, pages 247-248.

An element of ordinary copper oxide rectifier is formed by heating a disk of Cu about 1/16 in. thick in air or O to about 1040° C. whereby cupric and cupric oxides are formed; the latter is in a liquid state and reacts with the O in the air and the cupric oxide is dissolved in the cuprous oxide. The dissolved cupric oxide appears in the form of crystals embedded in crystals of cuprous oxide and separated from metallic Cu by a layer of practically pure cuprous oxide which makes this layer an imperfect dielectric and allows a leakage path to the electrons. This results in a slow discharge of the asymmetrical condenser metallic copper-cuprous oxide-cupric oxide. The theory of the density of electron flow is developed, the double-wave rectification is described and the action of the copper-oxide rectifier is explained; also explained by the ionic theory. Ha. (20)

The Influence of Curvature on the Strain Distribution in Cylindrical Helical Springs (Der Einfluss der Krümmung auf die Spannungsverteilung bei zylindrischen Schwaubenfedern). ROTHHAAS. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, October 17, 1931, pages 1315-1316.

A theoretical discussion and development of formulas for the determination of inner stresses in helical springs of very small diameter where the usual formulas no longer give correct results. 4 references. Ha. (20)

British Cast Iron Research Association. *Foundry Trade Journal,* Vol. 45, July 9, 1931, page 18; July 16, 1931, page 34; July 23, 1931, page 50; July 30, 1931, page 66; Aug. 6, 1931, page 80; Aug. 13, 1931, page 96; Aug. 20, 1931, pages 112, 124; Aug. 27, 1931, pages 128, 132; Sept. 3, 1931, page 142.

A brief outline of progress made by the B.C.I.R.A. since 1921. The first article is accompanied by a graph, showing the relationship between subscriptions and total income during the period 1921-1931. The manner in which the Government grant to the Association is handled is discussed and methods of levying subscriptions are also considered. The second article deals with the conditions of membership. The types of members described are (1) ordinary members, (2) trade and user members, (3) associate members. The terms of membership and the method by which the Association is governed are dealt with in some detail. The third article gives a description of the laboratories and the office accommodations. The fourth article contains a brief statement of the services rendered to the members. These services may be grouped as follows: (1) information from the library and information bureau; (2) confidential research reports on investigations in progress; (3) assistance in the application of discoveries made by the Association to particular industrial requirements and the solution of problems incidental to the production of castings. The fifth in the series deals with experimental work in progress. The program includes investigations on molding sands and refractories, heat-resisting cast iron, ingot-mold irons, malleable cast iron, cupola melting practice, light castings, alloy additions to cast iron, strength of cast iron in relation to design, and the structure and mechanical properties of gray iron in relation to melting conditions. In the sixth article, a brief statement is given of the advantages of the work of the B.C.I.R.A. to the foundry industry in Great Britain. The seventh article includes a brief statement of the government of the association. In the 2 concluding installments, the government is described in detail. Reference is made to the various technical sub-committees and the work covered by each. OWE (20)

Pocket Companion, Abridged Edition. Illinois Steel Company, Chicago, 1931. Paper, 6 x 9 inches, 318 pages.

The revised series of CB sections presented in this book is a joint compilation of the Carnegie Steel Company and the Illinois Steel Company. In addition to data pertaining to the CB series, information is also given covering the more commonly rolled sections used in structural design, as well as in car and ship building. Although the book is abridged in character, it contains all data ordinarily required by the user of structural shapes. M. L. Moorman (20)-B-

Marking Steel with Acid. *American Machinist,* Vol. 75, Aug. 27, 1931, page 343.

The fluid consists of nitric acid (38° Baumé) 75 parts, nitrate of silver 2 parts, water 23 parts. It can be used with pen or rubber stamp. Ha. (20)

The Light Metals at the 12th Milan Fair (I metalli leggeri alla XIIa fiera di Milano). *Metalli Leggeri,* Vol. 1, May-June, 1931, pages 12-24.

Description and photographs of exhibits. HWG (20)

Questions on Steam Turbine Operation (Fragen des Dampfkesselbetrieb). *Archiv für Wärmewirtschaft und Dampfkesselwesen,* Vol. 12, June 1931, pages 185-186.

Reviews meetings of and papers presented before Mitgliederversammlung der Vereinigung der Grosskesselbesitzer, Apr. 22, 1931, at Dresden. Papers were given by: Professor Bauer on "Boiler Injuries," Marguerre on "Operating Experiences with High-Pressure Systems," Lugberger on "Research Program for Alloyed Tubing." MAB (20)

The Dependence of Damping upon the Deformation Velocity (Die Abhängigkeit der Dämpfung von der Verformungsgeschwindigkeit). O. FÖPPL. *Archiv für Eisenhüttenwesen,* Vol. 4, June 1931, pages 607-608; *Stahl und Eisen,* Vol. 51, June 25, 1931, page 796.

In order to determine the dependence of damping on the deformation velocity, 3 different cases must be distinguished: (1) alternating loads below the yield point; (2) alternating loads with materials, the oscillating strength of which is above the yield point; (3) predominating flow of material with deformation. In the first case, the capacity of damping is independent of the deformation velocity; in the second case, the capacity of damping decreases with the velocity; and in the third case, the capacity of damping increases with the velocity of deformation. GN (20)

A New Research Tool. R. F. PASSANO. *Pure Iron Era,* Vol. 9, No. 39, page 23.

The principle of the statistical theory is explained and the importance of its application to research problems for evaluating test data is illustrated by means of an example. Ha. (20)

Fluid-Film Lubrication as Applied to Journal Bearings. F. O. WILLHOFFT. *Railway Mechanical Engineer,* Vol. 105, Aug. 1931, pages 410-411.

From the exhaustive paper the following summary is given: (1) The supply of oil must be sufficient at any speed to maintain an unbroken film of the necessary thickness over the whole load-carrying surface; it must also be sufficient to make up for oil lost by leakage at the 2 ends of the bearing. In order to preclude the breaking down of the film at any point, the supply must be greatly in excess of the requirements; according to tests, this amounts to about twice the oil loss through end leakage. (2) Oil should always be available at the loading edge of the bearing and over the whole length of it in sufficient quantity to permit formation and maintenance of a solid oil wedge; the edges of the bearings should, for this purpose, be rounded or chamfered. (3) The inside of the bearing in the pressure zones should not have any grooves or holes communicating with atmospheric or low pressure zones in order not to interfere with the building up of the pressure in a continuous oil flow. (4) The bearing arc should be long enough to permit the required maximum pressure; 90°-100° (sometimes even 60°) are sufficient. (5) The peripheral speed of the journal must be sufficient to permit the formation of the complete film of adequate thickness; the minimum speed at which greasy lubrication changes to fluid lubrication is still a question. Ha. (20)

FOUNDRY PRACTICE & APPLIANCES (22)

Molding Sand Condition is Related to Pin Holes and Low Ductility. GEO. BATTY. *Foundry*, Vol. 59, Oct. 15, 1931, pages 30-33.

The use of a proper molding medium has eliminated the sources of pin hole troubles by solving the problem of properly carrying off the gases from the mold. Green sand is suitable for the elimination of this trouble. It is explained why the addition of Al to shank ladles results in the formation of alumina. The various methods of addition are discussed. Ha. (22)

Some Fundamental Questions of Testing Molding Sands and their Utilization in the Foundry (Ueber einige grundsätzliche Fragen der Formsandprüfung und ihre Nutzbarmachung im Giessereibetrieb). AULICH. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Oct. 9, 1931, pages 793-800.

The characteristics of a molding sand are discussed and a tentative classification of sands according to contents of alumina and grain size is given. The mechanical-physical testing as the basis for maintaining uniformity of quality and the importance of water in the sand is discussed. Ha. (22)

Tests for the Use of Pig Iron Produced under Slag of High Alumina Contents as Addition for Gray Iron Castings (Ueber Versuche zur Verwendung von unter hochtonerdehaltiger Schlacke erzeugtem Roheisen als Zusatzeisen für Grauguss). M. PASCHKE & E. JUNG. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Oct. 2, 1931, pages 777-786.

In the Luebeck Blast Furnace Plant, a special pig iron is produced in the manufacture of an alumina fusion cement which has a composition of 4.5-5.3% C, 0.1-0.5% Si, about 0.5% Mn, 0.08-0.15% P, 0.01-0.03% S and up to 0.02% Al. The slag consists of about 45% $Al_2O_3+TiO_2$, 42% CaO and less than 10% SiO_2. This special iron, called H-K special pig iron, was tried as an addition to gray castings and steel. Segregation was very greatly reduced hereby and a good mobility was obtained in spite of very low P content. This promises well for castings of thin walls. The strength was good. This iron seems to give good results for hard castings and malleable castings also. Ha. (22)

Pattern Lumber Includes a Variety of Woods. NORMAN F. HINDLE. *Foundry*, Vol. 59, Sept. 1, 1931, pages 51-53; Sept. 15, 1931, pages 36-37.

Part I deals with the grading rules, defects and methods of drying pattern lumber. Part II. Mahogany, cherry, maple, beach and birch are hardwoods used more for the manufacture of patterns than other woods. Defects include knots, splits, wane, worm grub, rafting pin holes, etc. The question of seasoning is the basis of controversy among patternmakers. Case hardening is the most common defect in seasoned lumber. VSP (22)

Makes Largest Steel Casting. *Foundry*, Vol. 59, Sept. 1, 1931, pages 46-50.

Describes casting produced at Lehigh plant of the Bethlehem Steel Co. The weight of casting was 460,000 lbs. Gross weight of metal in casting, including sink heads, runners and gates was 580,000 lbs. The analysis of the steel used was: C, 0.20-0.25%; Mn, 0.45-0.50%; S, 0.04%; P, 0.025%; Si, 0.22-0.25%. VSP (22)

Proper Sand Control and the Low Ductility Problem. GEORGE BATTY (Steel Castings Development Bureau). *Iron Age*, Vol. 128, Sept. 24, 1931, pages 810-811, 819.

From a paper read before the American Foundrymen's Association. Low ductility in light steel castings is the product of higher physical properties with proper sand control. Pin-hole troubles and low ductility are identified with green sand practice. Mold gases and not gases coming from steel are the cause of pin-holes. The addition of Al is the major cause of low ductility. The opinions of other metallurgists are given. VSP (22)

The Graphic Calculation of Cupola Mixtures, with Special Reference to "Perlit" Cast Iron. *Foundry Trade Journal*, Vol. 44, May 21, 1931, pages 351-352.

An extended abstract of an article which appeared in *Die Giesserei*, wherein B. Szöke describes a graphic method with the aid of which the proportion of the different components of a mixture can be easily determined when the molten Fe is to contain a definite percentage of one of its constituents, e.g., Si. The method can be applied when 2 or 3 different kinds of pig Fe are used, together with returned scrap, gates, and risers, provided the latter contain the same percentage of Si as the molten Fe. The article is accompanied by 5 diagrams. OWE (22)

Casting of Beds of Large Machine Tools in Metal Molds (Giessen grosser Werkzeugmaschinenbetten auf Kokille). A. WINDHAUSEN. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Mar. 6, 1931, pages 204-206.

The procedure of molding pieces taking into consideration the deflection due to unequal wall-thickness, and the preparation of the metal molds is described in detail. Ha (22)

A Comparison of Natural-Bonded and Synthetic Moulding Sands for the Steel Foundry. H. J. COLE. *Foundry Trade Journal*, Vol. 45, Sept. 10, 1931, pages 159-161.

Extended abstract of paper presented before the A. F. A. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. OWE (22)

Complexities of the Steel Foundry. *Canadian Foundryman*, Vol. 22, June 1931, pages 12-13; July 1931, pages 10-11; Aug. 1931, pages 16-17.

Report of an address presented before the Steel Founders Society of America by Frederick A. Melmoth, who divides the complexities into 3 main groups—metallurgical, mechanical, and administrative. Methods of attacking the metallurgical problems of the foundry are outlined and improvements are dealt with which may be expected as a result of careful control of the factors involved. The mechanical problems are defined as those that become operative on the metal after it leaves the control of the molding department; these are dealt with in some detail and special reference is made to mold design and theories underlying it. The latter part of the paper deals with the question of casting, selling, and the choice of executives. See also *Metals & Alloys*, Vol. 2, Jan. 1931, page 15. OWE (22)

Sand-Spun Pipe. W. A. Brown (R. D. Wood & Co.) *Journal American Water Works Association,* Vol. 23, Apr. 1931, pages 551-560.

The manufacture and physical properties of "sand-spun" centrifugally-cast cast iron. VVK (22)

Correct Design of Castings. (Sachgemässes Konstruieren von Gusstücken.) *Giesserei-Zeitung und Giesserei,* Vol. 18, Jan. 16, 1931, pages 64-67.

The proper design of a pulley to obtain a casting free of internal stresses is shown. Ha (22)

Steel Foundry Practices Based on Study of Variables. F. B. Pletcher. *Foundry,* Vol. 59, June 15, 1931, pages 34-38.

The methods of handling, storing and testing of material for the operation of the foundry of the Burnside Steel Foundry Co., Chicago, are described in detail and some of the products are illustrated. Ha (22)

Melting Difficulties with Small Quantities of Special Iron. Ecossais. *Foundry Trade Journal,* Vol. 43, July 10, 1930, page 32.

Castings for engineering work must be close grained and reasonably free from blow and shrink holes. Typical analysis of the metal used is: total C, 3.2%; Ni, 1.2-1.5% depending on thickness; Mn, about 0.75%; P, about 0.35%; S, about 0.1%. This is poured at about 1350°-1400° C. In addition to using special irons, foundrymen often apply chills to equalize the rate of solidification of the thicker sections in order to overcome segregation and consequent open grain. VSP (22)

Progress Marks Malleable Casting Industry. E. E. Griest (Chicago Railway Equipment Co.). *Foundry,* Vol. 59, Sept. 15, 1931, pages 44-46.

Abstract of a paper read before the Quad-City Foundrymen's Association. Discusses gradual improvement in physical properties of malleable iron, the adoption of modern melting and other equipment and the development in the annealing process. VSP (22)

Carbon Can be Regulated by Cupola Practice. G. Olson. *Foundry,* Vol. 59, Apr. 1, 1931, pages 62-63.

The author believes that the C content of cast iron can be regulated very well in the cupola melting process by additions of steel scrap and gives a table showing the amount of scrap to be added for different amounts of C in charge and casting. Ha (22)

Clay and Sand Properties Play Important Part in Synthetic Sand Mixtures. N. J. Dunbeck. *Foundry,* Vol. 59, Oct. 15, 1931, pages 42-43.

The quality of sand and clay in the manufacture of synthetic molding sands has a great influence on durability, refractoriness, strength, moisture retentiveness. These points are discussed and simple tests for these properties are described. Ha (22)

What Will Prevent Blows and Pin Holes? Geo. Batty. *Foundry,* Vol. 59, Feb. 1, 1931, pages 69-70.

The moisture content of the sand near the face of the mold and the interparticle atmosphere of the sand is liable to promote defects in the casting. The ability of a molding sand to produce castings free from blows and pinholes has no strict relation to its permeability. Highly permeable facing is most dangerous when it is backed by a close, relatively impermeable backing sand. A good principle to observe in the manufacture of green-sand castings is to be sure that the permeability of the backing sand is not less than that of the facing sand. Ha (22)

Competitive Pressure Spurs Foundry Improvements. *Steel,* Vol. 88, Jan. 1, 1931, pages 286-287, 361.

Improvements in foundry products and processes have resulted from the economic depression. Institutions and private firms have fostered technical research and standardization. The foundry has made wider use of mechanical firing equipment and other labor-saving devices. Progress has been made in casting steel alloys of Ni, Cr, Mn, Mo and V; research has been carried out on casting alloys of Si, Cu, and Zn to replace Sn and on alloys of Mg and Be for aircraft manufacture. Advances have been made also in the short-time annealing of malleable iron in electric furnaces, in the heat treatment of gray iron and in the technic of die casting of Zn, Al and Cu base alloys. JN (22)

Match Plate Checking Methods Involve Extreme Accuracy. H. N. Tuttle. *Foundry,* Vol. 59, Feb. 15, 1931, pages 62-65.

Methods of accurate checking are illustrated. Ha (22)

Simplified Molding with Template (Vereinfachte Lehrenformerei). Freytag. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Oct. 23, 1931, pages 825-826.

The manner in which template molding can be carried out by workmen who are unable to read drawings is shown. Ha (22)

Molding Large Non-Ferrous Castings Requires Wide Experience. Edwin Bremer. *Foundry,* Vol. 59, Apr. 1, pages 48-51, 59.

General remarks on the importance of pouring temperatures, molds, number and arrangement of risers, cast-in baffle plates, etc.; examples are shown. Ha (22)

Pressure and Volume of Air in the Cupola (Etude de la pression et du volume d'air dans les cubilots). J. Canameras y Gonzalo. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 783-784.

2 cupola runs with a good coke and with a spongy, fragile coke showed the importance of coke quality. Even with higher pressure of air, 43 vs 40 gr./cm.^{2}, enough could be supplied, the furnace taking only 60 m.^{3}/min. against 63 with the better coke, and the iron was cold. HWG (22)

A Few Novelties in the Castings of Automobile Pistons (Quelques nouveautes pour la coulee des pistons d'Automobiles). *Revue Fonderie Moderne,* Vol. 25, Oct. 25, 1931, pages 379-380.

See *Metals & Alloys* (Fischer, *Giesserei,* Apr. 10, 1931), Vol. 2, Dec. 1931, page 319. Ha (22)

Annealing and Melting Furnaces for Aluminum, Especially Fuel-Fired Furnaces (Note sur les fours a recuire et les fours de fusion pour l'aluminium et ses alliages, en particulier fours chauffés). A. de Zeerleder. *Congres International des Mines de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 611-620. 17 figures.
Sketches of the construction and brief description of the performance of a wide variety of furnace types. HWG (23)

Dimensions and Capacities of the Checkers of Upper-Silesian Open Hearth Furnaces (Ueber Abmessungen und Leistungen der Wärmespeicher oberschlesischer Siemens-Martin-Ofen). F. Wesemann. *Stahl und Eisen,* Vol. 51, July 9, 1931, pages 873-883; July 16, 1931, pages 908-911.
Report 210 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The paper summarizes the results of a questionaire sent to the Upper-Silesian open hearth plants. GN (23)

The Physics of the Combustion of Solid Fuels (Zur Physik der Verbrennung fester Brennstoffe). P. Rosin & H. G. Kayser. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, June 27, 1931, pages 849-857.
Assuming that the combustion of coal on the grate should follow the same laws of flow as the dissolving of solid bodies in flowing liquids, the authors attacked the problem of the physics of combustion by observing the reaction between the surface of a solid body and a liquid because the same conditions hold good in combustion. A brick of finely ground salt pressed at 2000 atmospheres was chosen as a model and was exposed to the flow of water at different velocities. The reactions of a single body and of a bed of bodies as on a grate, the aero-dynamics of the grate and of combustion of powdered fuel are investigated and explained and relations are found for dimensions and arrangement of grates, directing of air, excess of air and incidental features of combustion. 15 references. Ha (23)

Economics of Electric Heating. N. R. Stansel (General Electric Co.). *Heat Treating & Forging,* Vol. 16, July 1930, pages 908-910.
From paper read before World Power Conference. Discusses economics of heating and use of electricity in the heat treatment of steel. Capacity of electric furnaces installed in the United States for heat treating steel amounts to about 300,000 kw. Use of electricity insures a high and uniform quality in the material treated. MS (23)

Physicing Bottoms of Dormant Open Hearth Furnaces. C. W. Veach. *Iron Age,* Vol. 127, Feb. 12, 1931, pages 546-547.
Some practical information on the means of putting an open hearth into condition again after it has been dormant for some time during which it has been cold and subject to natural deterioration. Ha (23)

The Changing Status of the Gas Produced in the Iron and Steel Industry. Geo. V. Slottman. Paper presented at *Third International Conference on Bituminous Coal,* Nov. 16-21, 1931 (Pittsburgh, Pa.).
The regeneration principle of Siemens, introduced in the steel industry since 1868, has led to an extensive consumption of gaseous fuel. While this was formerly covered by the gas producer, the by-product coke oven has, since 1914, begun to take its place and will ultimately eliminate the gas producer, altogether. For high temperature melting and reheating operations, coke oven-blast furnace gas mixtures are now being extensively used. The proper preparation of the raw gases from the blast furnace allows a more efficient utilization in the blast-furnace auxiliaries. In a properly balanced steel plant, the waste heat available from coke ovens and blast furnaces is more than sufficient to meet the total heat requirements; the use of solid and liquid fuels is confined to peak loads and to meeting irregularities in the supply of waste gases. Tables for coke production, relative proportion of solid, liquid and gaseous fuels used in American open-hearth furnaces, heat and power requirements/ton of ingot, and daily waste heat production and consumption are added. Ha (23)

The Action of an Eddy Current Melting Furnace for Low Frequency Three-Phase Current (Ueber Wirkungsweise eines Wirbelstrom-Schmelzofens für niederfrequenten Drehstrom) U. Schwedler. *Archiv für Elektrotechnik,* Vol. 25, Oct. 12, 1931, pages 669-682.
The theory of a furnace of this kind is developed and a testing arrangement for checking the calculations is described. Ha (23)

Rapid Open-Hearth Furnaces. N. E. Skaredoff. *Iron & Coal Trades Review,* Vol. 122, Jan. 16, 1931, page 81.
Furnaces designated by this name are able to give 5-6 charges daily irrespective of the capacity. Furnaces of this type mean a great economy in investment as well as in operation compared with the usual type of equal capacity or a small number of furnaces of a very great capacity. The author describes a construction in use at the Kamakshi Steel Works in Japan giving one charge of 25 tons every 4-5 hrs. The charge consists of 20-30% of molten pig from the blast furnace direct; 20-30% of cold pig and 35-50% of steel scrap. The fuel is coke-oven gas and coal tar, the consumption about 50 kg. of tar and 200 m.^{3} of gas which corresponds to 1,200,000 cal./ton of ingots (or 4,760,000 B.t.u./ton.) Ha (23)

Open Hearth Furnace Control. M. J. Conway. *Fuels & Furnaces,* Vol. 9, Aug. 1931, pages 919-920, 953; *Iron Age,* Vol. 128, July 23, 1931, pages 244-245, 278.
See *Metals & Alloys,* Vol. 2, Sept. 1931, page 189. Ha (23)

Possibilities of the Electric Furnace (Les possibilités du four electrique). P. Marthourey. *Congrés International des Mines, de la Métallurgie et de la Géologie appliquée. Section de Métallurgie,* 6th session, Liege, June, 1930, pages 227-245. 57 illustrations.
A general survey of progress of electric steel, with some attention to cast and malleable iron. A plea is made for the use of electric steel for rails. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 321. HWG (23)

On the Ultra Red Radiation of Refractories (Ueber die Ultrarotstrahlung feuerfester Körper). B. Wrede. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, No. 19, 1931, Report 179, pages 131-142; *Stahl und Eisen,* Vol. 51, Aug. 6, 1931, page 1007.
The ultra red radiation of various refractory bricks was investigated with a spectrometer and compared with the radiation of the black body. The investigation method is described and the results are tabulated and plotted in diagrams. In the table below, the capacity of absorption is the relation between the radiation of the brick considered and the radiation of a black body of the same temperature.

Radiator	Composition	Temperature ° C.	Capacity of absorption	Remarks
Silica brick	95% SiO_2,	1217	66	———
Chamotte	55% SiO_2, 41% Al_2O_3	1229	59	Surface rough
Sillimanite brick	33% SiO_2, 64% Al_2O_3	1402	29	———
Corundum brick	70% Al_2O_3, 30% clay	1344	46	Surface rough
Magnesite brick	80% MgO	1377	39	———

GN (24)

Special Refractories for Use at High Temperature. Wm. H. Swanger & F. R. Caldwell. *Brick & Clay Record,* Vol. 79, Aug. 25, 1931, pages 170-172.
The oxides of Th, Mg, Zr and Be can be used as refractories in which to melt metals of highest purity without injurious contamination of the metal by the refractory. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 190. Ha (24)

The Development of Some Special Refractories. H. E. White *Fuels & Furnaces,* Vol. 9, Sept. 1931, pages 1061-1066; Oct. 1931, pages 1155-1162.
In the beginning, the author points out that a faulty furnace design can never be overcome even by the best refractory. Silicon carbide, refractory cements, crystalline Al, mullite, high purity Mg, Zr (which possesses high mechanical strength under temperature) thermal insulation are discussed. Their properties and fields of application are described. Ha (24)

Refractory Materials for the Induction Furnace. J. H. Chesters & W. J. Rees. *Iron & Coal Trades Review,* Vol. 123, July 17, 1931, pages 78-79; July 24, 1931, pages 122-123; July 31, 1931, page 156.
The induction furnace offers particularly difficult problems in the production of durable linings which, beside refractoriness and chemical durability, must possess resistivity to severe strains imposed on it by the rapid rate of heating and the steep temperature gradient between the molten metal and the water cooled coil. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 190. Ha (24)

The Thermal Expansion of Some Refractory Oxides. James Bliss Austin. *Journal of the American Ceramic Society,* Vol. 14, Nov. 1931, pages 795-810.

Material	Total expansion between 20° and 1000° C. in parts/10,000 ∥ principal axis		Total expansion between 20° and 1000° C. in parts/10,000 ⊥ Principal axis	Thermal conductivity of brick at 500° C.x10[4]
Quartz (SiO_2)	87		169	
Magnesia (MgO)		135*		103
Alpha alumina (Al_2O_3)	89		82	82
Zirconia (ZrO_2)	56		89	42
Chromite ($FeO \cdot Cr_2O_3$)		80*		39
Zircon ($ZrO_2 \cdot SiO_2$)	60		33	—
Mullite ($3Al_2O_3 \cdot 2SiO_2$)	55		44	—

*Relation to principal axis not given.

The Pulfrich-Fizeau interference method as modified by the Bureau of Standards was employed in making the measurements. There appears to be no conclusive evidence at hand as to the relative expansion of a single crystal and an aggregate. In most cases the expansion of the aggregate is lower than that of the single crystal. Commercial brick would therefore have an expansion somewhat lower than its chief constituent in the pure crystalline state. WAT (24)

Refractories for Use in Tunnel Kilns. M. C. Booze. *Fuels & Furnaces,* Vol. 9, Feb. 1931, pages 205-212.
Description of the various kinds of refractories and their requirements as determined by service conditions up to 2000° F., as well as some installations. Ha (24)

Refractories Industry Awake to Value of Research. *Steel,* Vol. 88, Jan. 1, 1931, pages 292, 359.
The refractories industry is being elevated from rule-of-thumb methods to a new era of engineering precision by virtue of the research work being prosecuted in manufacturing plant laboratories and in government, society and institutional laboratories. The past year has witnessed a more general use of continuous kiln burning methods, the production of special shapes and materials, the development of a crystalline, aluminum-bodied brick, the wider adoption of zirconium oxide refractories, improvements in furnace linings, the production of electrically fused magnesia for furnace linings, the development of high temperature cements and new patching materials for furnaces, a more extensive use of chromite ore refractories, and a more general adoption of the power press process of brick manufacture. JN (24)

Foundry Refractories. Jas. R. Allen. *Fuels & Furnaces,* Vol. 9, June 1931, pages 669-670.
A review of the standardization of fire bricks and some of the standards already adopted. Ha (24)

Lining for Electric Furnaces. *Brass World,* Vol. 27, July 1931, page 156.
A new lining material, Furnaseal C-8 (Super Ram), for electric furnaces is marketed by Laclede-Cristy Clay Products Co., St. Louis, Mo. It is claimed to be useful in patching linings of furnaces for metal melting. Monolithic linings are produced and patches made with it become homogeneous with the lining. It has high slag resisting properties. Maintenance is reduced to a minimum, the material burns very hard and withstands abrasion well. It is recommended for furnaces melting Ni and Cu alloys. WHB (24)

GASES IN METALS (25)

Solubility of Oxygen in Solid Iron. N. A. Ziegler (Westinghouse Electric & Mfg. Co.). *American Society for Steel Treating, Preprint* No. 1, 1931, 10 pages.

Paper presented at the Boston Convention of the Society, Sept. 1931. Bibliography of 34 references. The author briefly discusses previous work and the vacuum method of analysis for O. The author's procedure of saturating samples of low C iron with O at various temperatures is described. From analyses of these samples, a curve of O content against temperature is shown. Up to 700° C. (1292°F.) the O content is negligible increasing slowly to 900° C. (1652°F.) and rapidly thereafter to reach a maximum of 0.10% in the neighborhood of 1000° C. (1832° F.). The effect of C on the solubility of O is quite marked as shown by a curve. WLC (25)

The Hardness of Electrolytic Nickel and Iron (La dureté du nickel et du fer électrolytique). Guichard, Clausman, Billon & Lanthony. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 525-526.

Evolution of H_2 and of $CO+CO_2$ on heating was studied in relation to the change of hardness. Practically all the H_2 is released from Ni before the hardness drops materially. Softening is practically complete before evolution of $CO + CO_2$ is appreciable. In the period where the hardness drops from about 240 to about 45 Brinell, the H has been released, and the $CO+CO_2$ have not yet been evolved. The gas contained in electrolytic Ni cannot be the cause of its hardness. A similar situation was found in Fe, the hardness remaining at about 365 after most of the H has been released. Evolution of $CO+CO_2$ occurs at lower temperatures than with Ni, but it is not thought by the authors to be a cause of softening. The hardness of the electrolytic deposits of both Ni and Fe is ascribed to small grain size. HWG (25)

Oxidation—a Cause of Porosity in Leaded Bronze. E. Doughty (Federal Mogul Corp.). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 181-183.

The author reports results obtained with a bearing bronze 80% Cu, 10% Sn and 10% Pb by melting under a reducing atmosphere, by deoxidizing oxidized metal with cupro-phosphorus and with zinc. Self-fluxing from oxides lighter than the metal is possible but heavy oxide of Pb does not rise out of the bath and results in porosity unless some powerful deoxidizer is used. WLC (25)

Nitrogen in Mild Steel. *Metallurgist,* Dec. 1930, pages 186-188.

An extended critical review of a paper by Köster ("The Problem of Nitrogen in Commercial Steel," *Archiv für Eisenhüttenwesen,* Apr. 1930 page 637). The causes of some of the changes in the properties of commercial steel which occur during mechanical and thermal treatment at temperatures below A_1 are still obscure. Mechanical "aging" —the term applied to the loss of toughness of cold-worked steel—and magnetic "aging," which consists in a deterioration of the magnetic quality in the course of time, are phenomena which still need a clear explanation. As a result of his work, Köster suggests that as these changes occur in the α iron phase, they cannot be of an allotropic nature, but must be constitutional and that. therefore, the solubility of certain substances in α iron must be dependent on the temperature. The usual impurities in iron, such as oxides, sulphides, etc., are probably soluble only to a very small extent, and the problem of investigating their effects requires the use of methods which are sufficiently sensitive. The solubility of nitrogen in α iron, as deduced from a number of experiments, is as follows: at room temperature, 0.001% N; at 200° C., 0.005% N; 300° C., 0.01% N; 400° C., 0.02% N. The presence of carbon in the super-saturated solution retards the precipitation of nitride at the lower temperatures. The effect is more pronounced with larger percentages of carbon and the separation of nitride may even be entirely suppressed. The separation of nitride is accompanied by a small increase in the specific gravity, the tensile strength and hardness are diminished, the angle of twist and the reduction of area are increased and the yield point and elongation are not markedly affected. The change in the mechanical properties is proportional to the percentage of nitrogen. Alloy steels are capable of retaining larger quantities of nitrogen in solution. VVK (25)

The Fixation of Gases (Hydrogen, Nitrogen) to Highly-Disperse Metals (Iron, Nickel) Deposited from the Vapor Phase (Ueber die Bindung von Gasen (Wasserstoff, Stickstoff) an hochdispersen, aus der Dampfphase abscheidenen Metallen (Eisen, Nickel). W. Frankenburger, K. Mayrhofer & E. Schwamberger. *Zeitschrift für Elektrochemie,* Vol. 37, Aug-Sept. 1931, pages 473-482.

If Fe is slowly evaporated and condensed on a cooled surface, the fine particles are able to bind very large amounts of H. The purpose of the investigation was to note if Ni, Pt, Mo, W and Ta behaved in a similar way and if, beside H, Ni, A and mixtures of Ne and He were also absorbed. The amount of the absorbed gas per metal atom was determined, also, as a function of the ratio quantity of NaCl/quantity of metal. The tests are described in detail; for the discussion, the results of the paper must be referred to. 15 references. Ha (25)

The Absorption of Nitrogen by Steel. R. S. Dean. *Heat Treating & Forging,* Vol. 17, May 1931, pages 460-464.

Report of U. S. Bureau of Mines No. 3076. The Fe-N diagram is a simple solubility curve increasing with temperature. Without cold working, the iron nitride when precipitated does not go into solution on long periods of heating below 300° C. The presence of nitrides may cause blue brittleness and hardening, even at very small percentages of N. The mechanical properties, in general, may be influenced in unexpected ways. The magnetic qualities show no permanence in the presence of N, either. These questions and the role of other additions and impurities, the use of possible denitrifiers are thoroughly discussed. It is recommended that the steel maker find means of controlling the N content of at least part of his metal. At present, no proven method for doing this exists. 37 references. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 281. Ha (25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Silicon Brasses. *Metallurgist,* June 1930, pages 95-96.

Extended abstract of H. W. Gould & K. W. Ray in *Metals & Alloys,* Vol. 1, 1930, page 455, 502. See *Metals & Alloys,* Vol. 1, Aug. 1930, page 685. VVK (27)

The Influence of Bismuth on Cast Iron. E. K. Smith & H. C. Aufderhaar. *Foundry Trade Journal,* Vol. 45, Sept. 3, 1931, pages 149-150.

An article extracted from *Iron Age.* See *Metals & Alloys,* Vol. 2, Nov. 1931, page 282. OWE (27)

The Effect of Molybdenum on Medium-Carbon Steels Containing 1 to 2.5 Per Cent of Manganese. G. Burns. *Engineer,* Vol. 152, Oct. 2, 1931, page 347; *Iron & Coal Trades Review,* Vol. 123, Oct. 2, 1931, pages 490-491.

Exhaustive tests were made on the effect of Mo on the mechanical properties susceptibility of steels containing 1.3 and 2.3% Mn to temper brittleness and their tendency to mass effect. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 323. Ha & LFM (27)

Silicon in Steel Making. Henry D. Hibbard. *Fuels & Furnaces,* Vol. 9, Sept. 1931, pages 1037-1051.

A full discussion of the very important functions of Si in steel making and the properties it imparts. Its occurrence in the charge material; the control of boil of the bath; gases in crude iron; dead bath; hot Bessemer blow; in the melting and working period; reversion of Si; additions of Si at different stages; preventing formation of gas holes; killing; lessening segregation in the ingot; silica in acid and basic slag; promoting of fusibility; raising tensility; lessening electric power losses; retarding corrosion; the time required for the different functions are treated in detail. Ha (27)

The Effect of Molybdenum and Titanium Upon Grey Cast Iron. *Foundry Trade Journal,* Vol. 45, July 16, 1931, page 39.

Abstract of an article by J. H. Küster and C. Pfannenschmidt (in *Die Giesserei,* 1931), accompanied by a diagram showing the effect of increasing the Mo content on the graphite content, the resistance to shock, the Brinell hardness number, and the transverse and tensile strengths of cast Fe containing about 3.4% total C and about 2.5% Si. Another diagram shows the effect of introducing Ti into a number of cast irons of varying Si contents. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 282. OWE (27)

Influence of Silicon on Nickel Steel. R. Harrison. *Iron & Coal Trades Review,* Vol. 123, Oct. 2, 1931, page 494.

In a steel of 4% Ni, 0.4% C, 0.3-0.8% Mn and 0.05-0.87% Si, the latter raises the critical points and has a hardening effect, whether in the forged, rolled or normalized condition. See *Metals & Alloys,* Dec. 1931, page 323. Ha (27)

The Effects of Iron on the Electrical Conductivity and Tensile Strength of Aluminum. M. Kuroda. *Supplement, Scientific Papers Institute of Physical and Chemical Research,* Vol. 16, Sept. 5, 1931, pages 1-2.

By the addition of electrolytic Fe to Al at melting, the electrical resistance and tensile strength increase proportionally to the Fe content. For each 1% of Fe in aluminum with 0.3-0.4% Si, the variation is 0.15 microhm for resistance and 1.5 kg./mm.^{2} for strength. For practical use as transmission wires, an Fe addition is preferable for strength as well as for conductivity. 20 references. Ha (27)

Alloy Additions Improve Gray Iron Pressure Castings. F. J. McGrail. *Foundry,* Vol. 59, Jan. 15, 1931, pages 52-55.

The addition of Cr and Ni has a favorable influence on the structure and properties of cast iron. The iron must be heated to 2600° F. to obtain proper results in melting Cr and Ni in the iron. This alloy is good for use in motor cars, steam or hydraulic cylinders. The ratio of Ni to Cr should be about 3-4-1, except in very heavy sections of 1½ ins. or more, when additional amounts of Cr can be added. The use of 2 Ni equals 1 of Si for the same C content. The proper method of mixing is explained and the structures are shown in micrographs. Ha (27)

Alloys at Work. *Inco,* Vol. 10, No. 4, 1931, pages 9-10.

A brief enumeration of the advantages of Ni as an alloy material and some applications. Ha (27)

Zirconium Additions Affect Steel and Gray Iron. *Foundry,* Vol. 59, Oct. 15, 1931, pages 44-46.

Comparative tabulations showing the beneficial influence of small additions of Zr to castings are given. Resistance to impact and hydrostatic pressure are greatly improved; strength and deflection are improved to some extent. A decided refinement of the grain structure was noted; this resulted from the deoxidizing and denitrogenizing effect of Zr. It is added in the form of zirconium-ferrosilicon containing 12-15% Zr, 40-45% Fe and 39-43% Si; as Si-Zr; or as Zr-Mn-Si. Methods of making these additions are described and the amounts to be added are given. Ha (27)

Gun Metal Strength is Affected by Phosphorus. H. C. Dews. *Foundry,* Vol. 59, Mar. 1, 1931, pages 63-65.

The effect of P on the admiralty gun metal, or the 88-10-2 alloy, was investigated. It was found that between 0.04 and 0.07% P, a sharp reduction of tensile strength takes place. Brinell hardness increases up to the addition of 0.04% and then decreases. Density decreases as the P is increased from 0.06 to 0.13%. P promotes the ease of casting and the casting temperatures have an influence on tensile strength and elongation, as is disclosed by curves taken between 1250° C. and 1000° C. Around 1100° C., a maximum exists in various alloys. The tests are described in detail. See also *Metals & Alloys,* Vol. 1, Oct. 1930, page 789. Ha (27)

Seasoning of Steel, Effect of Carbon, Nitrogen and Copper in Small Amounts. E. W. Ehn (SKF Companies, Cannstadt, Germany). *Metal Progress,* Vol. 20, Sept. 1931, pages 59-64.

The author presents equilibrium diagrams showing solubilities in α iron of 0.04% C, 0.50% N, and 3.5% Cu. The solubility increases with temperature and the values given are the maximum solubilities. Quenching from elevated temperatures still within the α range results in substantial supersaturation. Aging or drawing such quenched material results in precipitation hardening of the alloy. Treatments applicable to Fe-C, Fe-N and Fe-Cu alloys are discussed with properties obtainable. Effects of Cr, W and Be are discussed briefly. WLC (27)

INSTRUMENTS & CONTROLLERS (28)

The Use of Pyrometers in the Brass Foundry (Die Verwendung von Pyrometern in der Messinggiesserei). G. Wolfe. *Giesserei mit Giesserei-Zeitung* Vol. 18, Aug. 7, 1931, pages 639-642.

The necessity of supervision of the pouring temperatures for brass is pointed out and the possibilities and types of pyrometers answering this purpose are described. The only satisfactory thermo-couple is that for direct immersion but no type has yet been developed that does not show a great wear. The use of bare wires which are simply pressed together and can be easily renewed after burning off is, therefore, recommended. The optical pyrometers have not given satisfaction on account of the surface of the molten metal. Ha (28)

Temperature Regulators for Metallurgical Furnaces (Ueber Temperaturregler an metallurgischen Öfen). F. Kofler & G. Schefels. *Siemens-Zeitschrift,* Vol. 11, Oct. 1931, pages 448-453.

Describes the electrical connections of a temperature regulator for blast-furnaces, annealing furnaces, and pusher type furnaces. Ha (28)

The Remote Measuring Equipment of the Friedrich Alfred Plant at Rheinhausen (Die Fernmessanlage der Friedrich-Alfred-Hütte zu Rheinhausen). J. Wittig. *Stahl und Eisen,* Vol. 51, Sept. 17, 1931, pages 1161-1164.

The paper gives a detailed, illustrated description of all equipment controlling the energy of the plant mentioned above. The remote measuring equipment is centralized in 3 places and composed of a central measuring station for gas, air and compressed air, a station for controlling the blast furnaces and stoves and one station for the water plant. GN (28)

Automatic Control of Open-Hearth Furnaces. W. Trinks. *Mining & Metallurgy,* Vol. 12, Aug. 1931, pages 360-364.

The automatic control of combustion air, of maintenance of proper pressure in the furnace, of temperature and the means for doing it are discussed. It is noted that automatic control is usually more efficient and more cheaply done than regulation by hand. Ha (28)

Temperature Measurements in the Foundry (Wärmetechnische Messungen in der Metallgiesserei). W. Winkhaus. *Giesserei mit Geisserei-Zeitung,* Vol. 18, Mar. 13, 1931, pages 227-229.

The article deals, in a general way, with the influence on the quality of the product of temperature in drying, melting and pouring, and points out the importance of measuring instruments in the production of sound castings. Supervision of temperatures by recording instruments and of consumption of fuel oil with counters, immersion pyrometers with large scales for melting and automatic recording instruments are briefly discussed and explained. Ha (28)

The Use of Thermo-Couples at High Temperature (Ueber die Verwendung von Thermoelementen in hohen Temperaturen). A. Schulze. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, June 6, 1931, pages 731-733.

A few recent thermo-couples are described of which the Heraeus couple "32/40" consists of an alloy of gold, palladium and some platinum against a platinum alloy and has, over a range of from 0° to 1200° C. a considerably higher (about 5 times) EMF than the Le Chatelier element of platinum-platinum-rhodium, but its proportionality is poor. Another couple of nickel-nickelsteel can be used up to 1100° C. and one of nickel-carbon up to 1200°; the EMF of both is about half of the constantan-iron couple which, however, is good only up to 900° C. For very high temperature above the melting point of platinum a couple of pure tungsten and 75% W with 25% Mo has been made which is good for 3000° C.; this couple, however, reverses its direction of EMF at about 1200° C. At 500 to 700 volts it has 1.0 mV and at 3000°—6 mV. Ha (28)

Cycle Control for Heat Treating Furnaces. L. B. Crossman. *Fuels & Furnaces,* Vol. 8, Nov. 1930, pages 1551-1552.

A description of the construction and operation of a program control as applied to gas-fired heat treating furnaces. Ha (28)

Contact Pyrometers (Anlege-Pyrometer). W. Claus. *Zeitschrift für Metallkunde,* Vol. 23, Apr. 1931, pages 120-123.

It is important to determine the temperature of cast ingots prior to forging in order that the ingot may be worked at the most favorable temperature. Portable thermo-electric pyrometers for the determination of surface temperatures for this purpose are described, and the principles of their operation discussed. RFM (28)

Photoelectric Tube Pyrometer Controls High Furnace Temperatures. *Steel,* Vol. 89, Nov. 1931, page 36.

In the past it has been difficult to read the high furnace temperatures required in special furnaces used for industrial and laboratory purposes, and it has been difficult to control these furnaces or maintain a set temperature over a period of time. At the annual meeting of the American Chemical Society in Buffalo, in August, Dr. L. R. Koller (General Electric Co.) announced a solution for the problem in using the photoelectric tube to measure the visual energy radiated by the hot body and, thereby, its temperature. The photoelectric tube, with a suitable optical system, looks at the furnace wall, or some object in the furnace. The current in the tube depends on the amount of light falling on it and, accordingly, varies with the brightness of the surface observed. Temperatures as low as 1000° C. can be measured and there is no upper limit. The apparatus is equipped with the necessary amplifier tube, calibrated recorder and mounting stand. WAT (28)

An Air-Thermostat for Corrosion Research. U. R. Evans. *Journal Society Chemical Industry,* Vol. 50, Jan. 23, 1931, pages 66-67.

The principal features of an air-thermostat for corrosion research, details of which are given, are: double walls properly lagged between which, after passing through the main chamber, air is forced by a fan; windows placed where the experiment can be observed without disturbance. Provision is made for heating or cooling the air. A rotating horizontal shaft attached to a slow motion electric motor on the outside is provided for stirring purposes. VVK (28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts appearing in this section are prepared in coöperation with the Joint High Temperature Committee of A.S.M.E. and A.S.T.M.

Properties of Steel at High Temperatures. R. Willows & F. C. Thompson. *Metallurgia,* Vol. 4, Aug. 1931, pages 109-112.

Experiments were devised to determine whether or not a prolonged stress at elevated temperature affected the properties of steel at room temperature. 2 samples of C steel wire were used, containing 0.39% and 0.15% C respectively. Samples were maintained under a tensile stress at 100°, 200°, 300°, 400° and 500° C. for approximately 5 months. One sample was not loaded, another was loaded ½ of its tensile strength at room temperature and another at ¼. Samples held at 400° and 500° C. could not be loaded at such a high stress. Incidentally some creep values were obtained for the highest temperature. After testing at room temperature no effects of the stresses at elevated temperatures could be detected with the possible exception of the effects obtained at 500° C. Samples held at 300° C., including an unstressed specimen showed slight suggestions of embrittlement. It was concluded that definite embrittlement, which has been observed in practice must be due to some cause such as definite overstressing, vibrational fatigue, or possibly chemical attack. Contains 3 references. JLG (29)

Tempering Stability and Hardness at Elevated Temperature of High Speed Steel (Anlassbeständigkeit und Warmhärte von Schnelldrehstahl). F. Rapatz & H. Kallen. *Stahl und Eisen,* Vol. 51, Oct. 29, 1931, pages 1339-1340.

The authors determined the decrease of hardness with increasing drawing temperature and the hardness at elevated temperatures of various high speed steels containing variable contents of Co, W, Mo and V and a Cr content of 4.00- 4.60%. The results show that high alloy high speed steels have a better tempering stability than low alloy high speed steels. Whereas high alloy steels can be subjected to 600° C. for 15 hrs. without showing a remarkable disintegration of martensite, the low alloy steels show a disintegration even after 1.5 hrs. The hardness of elevated temperature of high alloy steels is also much higher than that of low alloy steels. This is observed even at those temperatures at which martensite is still stable for longer times, i.e., below 550°-600° C. These 2 properties, a greater hardness at elevated temperatures and a better stability during tempering, bring about the better qualities of high alloy high speed steel in comparison with low alloy high speed steel. GN (29)

Metallurgical Creep. *Engineer,* Vol. 151, May 8, 1931, page 506.

A letter by H. A. Humphrey of the Imperial Chemical Industries, Ltd., submitting a formula worked out by A. G. Hinton of the same firm. Proposed formula expresses the relation between stress and log creep strain. Following formula agrees closely with experimental results obtained:

$$C = k\frac{(p-a)^3}{(b-p)^2}$$

C=creep (strain/unit time), p=tensile stress, k, a, b are constants depending upon temperature. The constants have been determined for Ni-Cr, Cr-V, and a stainless steel at 300° C., 400° C., 500° C. and 600° C. and duralumin at 150° C. Figures are given showing points which were worked out experimentally and curves representing the above proposed formula. LFM (29)

Ferrous Materials to Resist High Temperatures. James A. Lee. *Chemical & Metallurgical Engineering,* Vol. 37, Sept. 1930, pages 587-588.

Summary of recent developments. MS (29)

The Red Shortness of Steel by Metals (Der Rotbruch des Stahles durch Metalle). H. Schottky, K. Schichtel & R. Stolle. *Archiv für Eisenhuttenwesen,* Vol. 4, May 1931, pages 541-547; *Stahl und Eisen,* Vol. 51, June 18, 1931, pages 769-770.

Appeared in *Krupp'sche Monatshefte,* Vol. 12, May 1931. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 193. GN (29)

The Characteristics of Deformation of Steel under Constant Load at Elevated Temperatures. G. R. Brophy (General Electric Co.). *American Society for Steel Treating, Preprint* No. 4, 1931; *Metal Progress,* Vol. 20, Aug. 1931, pages 54-57.

Paper presented and discussed before the Boston Convention of the Society in Sept. 1931. As result of the study of the deformation of steels under increasing loads and constant loads over a wide range of temperatures, 3 types of steel are recognized, (1) those which show more or less sudden yields above the proportional limit from room temperature up to some elevated temperature, above which the yielding becomes smooth; (2) steels which show smooth load-deformation curves at room temperature and at higher temperature but at intermediate temperatures stepped curves; (3) steels which show smooth curves at all temperatures. The influence of heat treatment on these diagrams and of heat treatment and pre-straining on time deformation curves are discussed. The idea is presented that "creep" is a strain hysteresis which may be mathematically predicted for long periods from tests conducted for shorter times. WLC (29)

The Influence of High Pressure Superheated Steam upon the Structure and Properties of Various Materials for Construction of Engines. Y. Fujii. *Kinzoku no Kenkyu,* Japan, Sept. 1931, pages 498-534.

18 kinds of steels and 3 kinds of Cu alloys, which at present are commonly used in the main parts of steam engines, were exposed in running steam of 35 kg/cm.² at 400° C. as in the actual case and the change of their structure and several properties were studied. Tensile strength, hardness, impact, fatigue and creep tests were also made at such high temperatures as 20°, 200°, 300°, 400° and 500° C. and compared with the results of the running steam tests. From the results, it is concluded that various steels tested are fit for the use in high temperature up to 400° C., though Cu alloys are not available above 200° C. KT (29)

Electric Furnace for High Temperature Tensile Tests (Elektrischer Ofen für Warmzerreissversuche). O. Beckmann. *Metallwirtschaft,* Vol. 10, Sept. 11, 1931, pages 725-726.

Description of construction details of an electric furnace which is attached to a testing machine, in which test pieces were heated for the determination of yield point and long time tensile tests of metals. The temperature is regulated by means of a rheostat between 100° and 1000° C. and determined by a thermocouple and millivoltmeter. A mirror device for measurement of elongation is part of the equipment. In the long time tests, the load was held constant by means of an Amsler constant pressure apparatus. This consists of an adjustable exhaust valve which works in connection with the hydraulic pressure pump. CEM (29)

The Temperature Relations in the Plasticity of Crystals (Ueber die Temperaturabhängigkeit der Kristallplastizität). W. Boas & E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalten,* Sonderheft 13, 1930, pages 103-109; *Zeitschrift für Physik,* Vol. 61, May 7, 1930, page 767.

A study of single crystals of known orientation of Cd from 20° absolute and of Zn from 85° absolute to the melting points. The influence of the rate of loading on the hardening curve at very low and very high temperatures is small. Curves of the observed data are given. The orientation in a Cd single crystal is not dependent on the work exerted in producing the gliding of the basal plane. This work is a constant (about 9 joules/cm²) at all temperatures. Zn single crystals stretched at 100°-200° C. show transverse markings which may perhaps be due to a tearing of the surface. HWG (29)

Some Considerations Affecting the Future Development of the Steam Cycle. K. Baumann. *Proceedings of the Institution of Mechanical Engineers,* No. 5, 1930, pages 1305-1396.

Includes discussion. Factors affecting and limiting the use of high temperatures and pressures are discussed, among which the creep properties of steels are important. Curves are given comparing the rate of creep in ins./in./hr. for 0.15% C carbon steel and for a Cr-Ni-Mo steel of 0.30% C, 2.50% Ni, 0.60% Cr, 0.60% Mo, 0.60% Mn, oil hardened and tempered to a room temperature strength of 135,000 lbs./in.². These curves show the following relation:

Temperature° F.	Load in lbs./in.² for creep rate shown: 10^{-8} in/in./hr. Carbon	10^{-8} in/in./hr. Ni-Cr-Mo	10^{-5} in/in./hr. Carbon	10^{-5} in/in./hr. Ni-Cr-Mo
750	6,500	22,500	21,000	67,000
800	5,000	15,500	16,500	56,000
900	2,500	5,500	9,500	33,000
1,000	1,500	2,500	4,500	11,000

These are based on creep tests, but, particularly at the lower rates of creep, "they should be regarded only as an intelligent anticipation of the creep properties." Creep curves at 400° C. (750° F.) are shown for 0.40% normalized C. steel loaded at 9,000 lbs./in.² and for Armco iron at 6,700 lbs./in.² The following data are taken from these curves:

	0.40% C	Armco
Initial extension, inches	0.00028	0.00026
Extension at 250 hrs.	0.00038	0.00052
" " 750 hrs.	0.00044	0.00057
" " 1500 hrs.	0.00047	0.00063
" " 2500 hrs.	0.00049	0.00067

Neither curve shows marked diminution of rate in the last 1,000 hrs. of the test. Important differences in rate of creep at 550° C. (1025° F.) are stated to have been found in Ni-Cr-Mo steels of apparently similar composition and heat-treatment and investigation was necessary to determine the thermal treatment for best creep resistance at this temperature. No details of the differences or of the heat-treatments are given.

Comment is made on the fact that the data from older investigations, such as those of Lea, tend to give values for apparently allowable loads that are really unsafe. Later, more refined, tests doubtless give more nearly true values. From the point of view of the designer of steam plants, considerable creep occurs at loads only 25% of those Lea designated as creep limits. Engineering factors concerning the permissible distortion of bolts and piping are considered in detail. In discussion, page 1375, H. E. Geer suggested that a material was needed which would provide ductility equal to that of mild steel at ordinary temperature but which will stand higher stresses up to 1100° F. and avoid the tendency toward brittleness and intercrystalline break-down which occurs with high Cr alloys. It appears that judicious addition of Mo and Cu might have the desired effect. Such a material has recently been brought out by a British steelmaker with which at 400° C. (750° F.) the creep stress is twice, and at 500° C. (930° F.), 3 times that of mild C steel. It is thought that this will make possible higher super heater temperatures, use of thinner tubing and consequent reduction of temperature stresses, beside avoiding danger of internal sealing. Baumann gives permissible creep rates in ins./in./hr. as 10^{-9} for turbine disks pressed on shafts, 10^{-8} for bolted flanges and turbine cylinders, 10^{-7} for steam piping, welded joints and boiler tubes, and 10^{-6} for super heater tubes. HWG (29)

Heat Resisting Steels. *Nickel Bulletin,* Vol. 4, Nov. 1931, pages 321-329.

Heat-resisting Ni-Cr steels, Ni 10-30% and in some cases as high as 60%, and Cr from 7-35%, are now available in all the usual forms. Mechanical properties of a number of types are given for room temperature. The "creep stress" is at present not definite. This is partly due to the fact that it has not been possible to explore all the various compositions, and also to the difference of opinion which still exists as to how the "creep limit" should be defined. Thus, while the results of one investigator are comparable, they are not necessarily interchangeable with those obtained by others. Results obtained by Hadfield, Pilling and Worthington, Henshaw, Bodmer, Aitchison, and others on the physical properties at temperatures from 20°-1000° C., of a number of Ni-Cr heat-resisting steels are given. Some of the numerous uses and applications of heat-resisting steels are enumerated and illustrated. WAT (29)

Limiting Creep Stresses. *Metallurgist,* Dec. 1930, pages 178-179.

The intensified demand of present day engineering practice for metals and alloys that will withstand high temperatures and pressures has placed before the engineer the problem of determining these properties sufficiently accurately that they can be used as bases for design without the introduction of an unnecessarily large safety factor. The difficulty is that, while the investigation of the behavior of materials over a long period of time is necessarily a slow process, the engineer is faced with the problems of the moment and cannot wait for the results of extensive research. The consequence has been a demand for quick approximate methods of determining the "creep stress" of a given steel at various temperatures, and several short cuts of this kind have been devised. It is questionable, however, whether the results of these short methods are sufficiently reliable for them to be used with confidence for design purposes. For relative purposes, the comparison of one steel with another, fairly safe conclusions can be drawn but for purposes of design, where the creep properties must be accurately known, the problem becomes more difficult and complicated. Such factors as the possible effects of gradual rearrangements of internal structure — recrystallization, spheroidizing, etc. — which scarcely come into play in a short time test, may make all the difference in the service life of the material. Cases are known, in fact, in which a material has apparently settled down to a steady and very low rate of creep—possibly even so low as to be practically negligible—and yet, after a certain lapse of time, the rate of flow has increased and rupture has occurred. There would seem to be 2 directions in which a solution of this problem can be reached. The first is an immediate and practical process, leading only to a tentative and temporary result. The engineer must determine, as far as present data will permit, the true creep stress (if such a thing exists), of his materials, increase his factor of safety where forward steps in design are taken and then carefully watch his structures to determine what actually happens. The second method of approaching a solution of the high-temperature problem lies along the road of research, and especially of fundamental research. The question has been raised whether there is a true "limiting creep stress" at high temperatures, or even at the temperature of the air. In regard to the latter point, both laboratory tests and engineering experience go to show that if materials "creep" under prolonged loading at low and moderate temperatures, the rate of creep is negligible for practical purposes and need not be taken into account, so far as steel and the harder metals are concerned, in questions of design. At higher temperatures and in the softer metals the state of affairs may be different and we are in urgent need of further knowledge. It may even be found that the structural condition of a material, determining not only its actual resistance to flow at any given moment during a test, but its stability or resistance to gradual internal changes of a deleterious character, may be of very great importance. VVK (29)

Cold-Treating Dural with Solid CO_2; Cold-Treatment of Alloy Steels. *American Machinist,* Vol. 75, Sept. 17, 1931, pages 439-441, 473.

The rapid age hardening at normal temperatures occurring in alloys of the duralumin type containing both Cu and Mg offers practical difficulties and uncertainties; for instance, when rivets are used which must be heat treated just before being used. The method of overcoming this inconvenience and preventing age hardening before time, by keeping them at about 32° F. immediately after quenching, is explained in detail. The relation between hardening or aging and temperature was investigated closely and diagrams show the changes in tensile strength as function of time elapsed between quenching and testing. In a similar way, alloy steels cold treated with liquid air show marked changes in hardness and physical properties. As an example, the following table for a steel with 17.15% Cr and 5.06% Ni is given:

Quenched from 1090° C. and cold treated at − 80° C. and drawn:

Treatment	Elastic Limit lbs./in.²	Ultimate tensile strength lbs./in.²	Elongation in 2 ins. %	Reduction of area %	Machinability r.p.m.	Brinell No.	B maximum H-300
As quenched	22,500	194,500	17.0	22.6	120	277	3540
C.T − 80° C.	72,500	231,200	8.4	9.6	88	444	9240
Draw 400° C.	100,000	208,000	19.8	64.3	160	444	9970
Draw 500° C.	82,500	187,200	20.6	65.8	221	387	10940
Draw 600° C.	65,000	153,600	19.4	55.9	221	321	8270

Appreciable increases in hardness were also obtained by cold treating a group of alloys containing from 24.73 to 30% Ni at − 180° C. The method of measuring the low temperatures and of testing are described and several tables showing the results are added. Ha (29)

Alloys for Use at High Temperatures. C. H. M. Jenkins & H. J. Tapsell. Parts I, II. *Foundry Trade Journal,* Vol. 45, July 16, 1931, pages 43-44; Part III. *Foundry Trade Journal,* Vol. 45, Aug. 20, 1931, pages 120-122; *Iron & Steel Industry & British Foundryman,* Vol. 4, Aug. 1931, pages 379-380.

Abridgement of a paper presented before the annual meeting of the British Iron & Steel Institute dealing with Ni-Cr and complex Fe-Ni-Cr alloys. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 284. OWE-CHL (29)

Applying Creep Stresses to Oil Still Tubes. R. S. Brown. *Petroleum Engineer,* Vol. 2, Midyear 1931, pages 137-138.

Special considerations entering into the application of stresses to still tubes and tube supports. Also some suggestions on the manner in which available data should be used. (29)

High Temperature Tensile Properties of Rail Steels. *Metallurgist,* Sept. 1930, pages 134-136; Oct. 1930, pages 147-149.

A review consisting primarily of an extended abstract of *Research Paper* No. 164 by Freeman & Quick on "Tensile Properties of Rail and Some Other Steels at Elevated Temperatures." See *Metals & Alloys,* Vol. 1, June 1930, page 565. VVK (29)

Nickel Chromium Alloys. *Electrician,* Vol. 107, Nov. 27, 1931, pages 718-720.

Methods of manufacture and physical properties at high temperatures are discussed. Forging and rolling, cold working and mechanical properties are included. WHB (29)

Destruction of Chrome Nickel Heating Elements. *Chemical Age,* London, Vol. 23, Dec. 6, 1930, Metallurgical Section, pages 33-34.

An extended abstract from a contribution of the Research Department of the Steatit-Magnesia A. G., Berlin. The causes of the destruction of the nickel chrome and other resistance wires used for electrical heating is the subject of an extensive series of tests resulting in the following conclusions. "The well known burning out of heating elements, a frequent source of trouble, is caused by the wire. Heating wires must obviously be treated much more carefully and considerately than is generally the case. The colored deposits occurring so extensively without the chemical or electrolytic coöperation of the ceramic material serve as a proof that overheating has taken place. When it is a question of the supply of radiating heat, a glowing temperature of 900° F. should be sufficient, and resistance wires and strips heated to much lower temperatures should be employed where only low temperature heating is required. If an arc occurs on the burning out of the heating wire, the ceramic element is also injured by the action of the oxides. The actual conductivity at high temperature of the ceramic material has much less importance than has hitherto been assumed." VVK (29)

Keeping Duralumin Rivets Workable in Dry Ice. E. P. Dean (Boeing Airplane Co.). *Metals & Alloys,* Vol. 2, Sept. 1931, page 165.

The forming properties of quenched duralumin rivets remain satisfactory for only very short times at room temperatures due to ageing; this has led to the method described of keeping them in boxes refrigerated by dry ice until they are used. WLC (29)

Quick Method of Determining Creep Strength. *Iron & Coal Trades Review,* Vol. 123, Nov. 27, 1931, page 831.

The creep limit is the maximum load which a material will stand at any given temperature under which the initial stretch gradually comes to an end. The determination of this limit requires a very long time. Pomp and Enders propose a practical method for quickly determining the creep resistance of steels. Short-time tensile tests are first made to determine the stresses which give permanent elongations of 0.01, 0.1 and 0.2%, respectively. Then the test pieces are subjected to steady loads corresponding to these stresses; the average rate of extension/hr. between the fifth and tenth hrs. is plotted for each of these loads. From the curve so obtained, the stress to give the specified extension of 0.003% /hr. during this period can be obtained. For more definite information, the tests should be extended another 40 hrs. with this stress under which the average extension between the 25th and 35th hrs. should not exceed 0.0015%. The results so obtained agreed very well with those of long-time tests extending over 2400 hrs. at from 300° to 500° C. Ha (29)

REDUCTION METALLURGY (31)

A Study of the Reducing Sintering of Powdered Iron Ores. G. Yamada. *Proceedings World Engineering Congress,* Tokyo, 1929, Vol. 33, published 1931, *Mining & Metallurgy,* Part 1, pages 497-531.

In English. Includes discussion. Various fuels were used for the sintering of a magnetite of 61.6% Fe, 14% SiO_2, with over 90% of the ore passing 150 mesh. The study also included examination of Bethlehem Steel Co., Greenawalt, and Swedish Greenawalt sinters, Manchurian Dwight & Lloyd Sinter, Manchurian Groendal briquets and commercial Japanese nodulized material. Analyses, strength, porosity, magnetic analysis and microstructure are given. The Japanese magnetite concentrate does not sinter well in an oxidizing atmosphere at 1350° C., but with 3 to 5% flue dust, anthracite or coke breeze, it sinters under 1150° C. through formation of the eutectic of ferrous oxide and ferrous orthosilicate. In discussion, E. Brauns expressed preference for coke breeze over anthracite. HWG (31)

Some Features of Lead Blast-Furnace Operations at the Works of the Broken Hill Associated Smelters Proprietary, Limited, Port Pirie, S. A. O. H. Woodward. *Bulletin, Institute of Mining & Metallurgy,* No. 321, June 1931, 27 pages; No. 326, Nov. 1931, 11 pages; *Proceedings Australasian Institute Mining & Metallurgy,* June 30, 1931, pages 57-86.

ZnO in the charge to the Pb blast furnace is the chief factor in the formation of shaft accretions, which upset the smooth operation of the furnace. When smelting such a charge the maintenance of a good smelting rate is essential. This is largely dependent upon the relationship between porosity and general average size of coke pieces. Coke must reach the tuyere zone; excessive accumulations of coke above the tuyeres lead to an intensely reducing atmosphere and high temperature at the tuyeres which causes Zn to distill from this zone and condense in the upper portion of the shaft. As coke accumulation continues the furnace slows up, the heat is driven further up the shaft, cementing action by ZnO is accentuated and the column ceases to sink. High CaO + high ZnO is undesirable and high FeO + MnO is desirable. To give good operation at Port Pirie the slag should show $(ZnO \times CaO)/(FeO + MnO)$ = less than 8.0 when SiO_2 is about 20%, 9.0 to 9.5 with SiO_2 about 22% and 7.0 to 7.5 with SiO_2 about 18%. When the tapping interval was 5 to 10 minutes, Pb in the slag was 2.26%; 10-20 minutes, Pb 1.93 %; 20-30 minutes, Pb 1.6%; more than 30 minutes, Pb 1.51%. The longer interval was possible only through raising the tuyeres. This also eliminated deep-seated accretions and prevented accumulation of coke above tuyeres. AHE (31)

Statistical Analysis of Blast-Furnace Data. Richard S. McCaffery & Ronald G. Stephenson. *Rolling Mill Journal,* Vol. 5, Mar. 1931, page 170.

A study of the effect of variation of slag composition on coke consumption, daily tonnage of pig iron, and S elimination. Abstract of a paper presented at the New York Meeting of the American Institute of Mining and Metallurgical Engineers, week of Feb. 16. See *Metals & Alloys,* Vol. 2, Apr. 1931, page 91. JN (31)

Blast Furnace Losses of Carbon by Solution and by Direct Reduction (Le perdite di carbonio per soluzione e per riduzione diretta nella loro importanza assoluta e comparativa). G. V. D. Mirandola. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session Liege, June 1930, pages 87-93.

Discussion of the physical chemistry involved. 2 figures are given showing equilibria. HWG (31)

Sponge Iron Low in Impurities by Ekeland's Process. Correspondence from E. Oehman, Stockholm, Sweden. *Metal Progress,* Vol. 20, Oct. 1931, pages 89-90.

Reduction of ore with producer gas to sponge iron of high purity is described. WLC (31)

Hot Blast Furnace Problems. Wm. McConnachie. *Blast Furnace & Steel Plant,* Vol. 18, Dec. 1930, pages 1827-1828.

A study of the removal of the O from the ore and the part played by the gases produced in combustion. Ha (31)

The Importance of the Cyanides in Iron Smelting. W. McConnachie. *Iron & Steel Industry & British Foundryman,* Vol. 4, Sept. 1931, pages 396-398.

Utilizing data of former investigators, the author deduced that cyanides are formed below the tuyere level in the blast furnace in amounts equal to at least 200 lbs./ton pig iron produced. Since 200 lbs. KCN will remove the O from the Fe in about 300 lbs. pig iron, its presence is of great importance in the furnace. CHL (31)

Carbon in the Blast-Furnace Well. Wm. McConnachie. *Blast Furnace & Steel Plant,* Vol. 18, Oct. 1930, pages 1629-1630.

From available data on the role of C in the different parts of the blast furnace, some conclusions are drawn with regard to the heat requirements of the furnace; this field is not yet sufficiently elucidated. Ha (31)

Method for Computing a Blast Furnace Charge (En Beskickningsberäkningsmetod). Arvid Johannsen. *Jernkontorets Annaler,* Vol. 115, May 1931, pages 230-236.

The principle of the calculation, which is used for the students in Royal Polytechnical College (Sweden), is to determine for each ore its excess or deficiency of pure $CaCO_3$ for the formation of slag of a given silicate content. The necessary lime and silica is then computed from these values. The advantage of the relatively simple method is its rapid application in daily practice. HCD (31)

The Blowing-In of Blast Furnace Dust into Blast Furnaces according to the Heskamp Method (Das Einblasen von Gichtstaub in Hochöfen nach dem Heskamp-Verfahren). R. Milden. *Stahl und Eisen,* Vol. 51, Sept. 10, 1931, pages 1133-1135.

According to the Heskamp method, the dust is accumulated in a vessel and blown from there into the shaft of the blast furnace by means of compressed blast furnace gas of 4-6 atmospheres pressure. The proper height of the nozzles blowing-in the dust must be determined by experiment. In comparison with the sintering of blast furnace dust, the direct blowing-in into the furnace offers the advantage of a small first cost and small costs of operation. The operation of the blast furnace is not unfavorably affected by this method. GN (31)

Modern Blast Furnaces in Belgium. *Iron & Coal Trades Review,* Vol. 122, Jan. 9, 1931, pages 37-39.

A few examples of post-war construction and the details of design are given for units up to 1100 tons/day. Ha (31)

The Use of Limestone in the Iron and Steel Industry. OLIVER BOWLES (U. S. Bur. of Mines). *Rolling Mill Journal,* Vol. 5, Feb. 1931, pages 87-90; Mar. 1931, pages 167-170.

The metallurgical industries use 23,000,000 tons of limestone annually. 90% of this is used in blast furnace practice and most of the remainder in basic open-hearth steel furnaces. It requires 900 lbs. of limestone to produce one ton of pig iron. The chief impurities in both limestone and iron ore are sand and clay. S is also encountered, either in the ore or in the coke. The "available carbonate" in a limestone is determined by chemical analysis. About one lb. of lime (CaO) is required to neutralize one lb. of mixed silica and alumina. Dolomites, which yield lime and magnesia, are widely used in England in place of limestone. For high sulphur ores, a high calcium limestone is preferable. A good average limestone should contain less than 0.5% S and less than 5% total impurities. Sizes of lumps usually range from 4½ to ½ in. In average practice, about ½ ton of slag is formed/ton of Fe. Much of this is employed in road material, in concrete mixes, and in the manufacture of Portland cement.

Part II. The purpose of a limestone flux in the basic open-hearth furnace is to remove P and S. (The phosphatic slags obtained are used as fertilizers.) The avoidance of impurities in the limestone is much more important here than in blast-furnace practice, because of the difference in composition of the slag. Specifications are more rigid: silica must not exceed 1% and alumina 1.5%. A high calcium content is preferred and magnesia must not exceed 5%. The requirements as to particle size vary, but fines under 2 in. are usually excluded. Dead-burned magnesite ($MgCO_3$) and dead-burned dolomite ($MgCO_3+CaCO_3$) are both used for lining furnace bottoms, although the use of dolomite is generally confined to repair work. JN (31)

Vieille-Montagne Procedure in Super-Roasting Blendes. (Super-grillage des blendes, procédé de la Vieille-Montagne.) J. DE BELLEFROID. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 469-470.

By roasting down to 0.3-0.6% S, recovery of zinc from blende is increased 4 to 5%. The super-roasted material is 10 to 20% more dense, hence more can be charged at once and production thus increased. HWG (31)

Economical Aspects of the 1000-Ton Blast Furnace. H. A. BRASSERT. *Blast Furnace & Steel Plant,* Vol. 19, Jan. 1931, pages 89-91, 98.

From a study of present conditions, the author concludes that, with certain improvements which he discusses, the 1000-ton furnace will be able to combine large production with economical operation which may even lead to larger outputs. Such furnaces of larger capacity will, however, be installed only in conjunction with smaller units in order to preserve a good flexibility of the plant necessary for times of reduced demand. Ha (31)

Manganiferous Iron Ores and Their Influence on the Production of Iron and Steel in Australia. *Chemical Engineering & Mining Review,* Vol. 23, July 6, 1931, pages 381-382.

Australian iron ores consist of high-grade hematite with some of the ore richer in Mn. These ores are easily graded separately, making it easy to maintain regular supplies of manganiferous iron ores for use as charged ore in the steel plant. The advantages of high-manganese iron ore charges are indicated. WHB (31)

The Rotary Process of Extracting Metals. E. GOSSOW. *Engineering Progress,* Vol. 12, Jan. 1931, pages 20-21.

A "rotary" process of extracting metal economically from low grade ores is described. It is especially suitable for Zn. The raw material is continually fed, mixed with proper additions, fuel, etc., into the rotary kiln. Reduction and oxidation of the Zn may be made so as to coincide, as to time and space, so that both processes take place as a single thermic event. Installation and operation of a plant are described. Ha (31)

Mining Arsenical Ore in Sweden. OSCAR FALKMAN. *Engineer,* Vol. 152, July 24, 1931, page 96.

Translated from *Skandinaviska Kreditaktiebolaget.* Describes smelting plant started at Rönnskär in 1928. The ore is obtained from a deposit at Boliden discovered by electrical prospecting in 1925. The ore is a mixture of arsenical and iron pyrites containing Cu and Au. The Cu content averages 2% and the As 10%. Due to the high content of As, the usual smelting method is modified. The ore is crushed and goes to mechanical roasters for the removal of the As. Gases from the roasters are cooled to the point at which As condenses. Part of the As is settled out and the remainder is recovered in electrical precipitators. As is now being used for preservation of timber and of concrete constructions. LFM (31)

Economies in Blast-Furnace Operation. J. P. DOVELL. *Blast Furnace & Steel Plant,* Vol. 19, Jan. 1931, pages 118-120.

The article enumerates and explains some of the fundamentals on which successful practice is dependent such as hot blast, distribution of gases, preparation of raw materials. Ha (31)

Rationale of Dry Blast in Iron Smelting. W. MCCONNACHIE. *Iron & Steel Industry & British Foundryman,* Vol. 4, Apr. 1931, pages 223-225.

Dry blast requires less fuel than is necessary with ordinary blast. The hypothesis advanced by J. E. Johnson, Jr. to account for fuel economy is far from satisfactory. The author believes that a possible difference in temperature explains the economy in fuel reported. The temperature in the upper part of the furnace run on dry blast is lower than when ordinary hot blast is used and, therefore, a greater amount of C is deposited in this region. With favorable temperature conditions, sufficient C is deposited from the CO of the gas to directly reduce the ore. This will make for economy in fuel. CHL (31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Special Lining of Pipe Insures the Retention of Carrying Capacity of Cast Iron Mains. ALEXANDER POTTER. *Water Works Engineering,* Vol. 84, Nov. 4, 1931, pages 1545-1546, 1567.

The economic life of cast iron mains must be based, not on the long life of the pipe, but upon the value of the carrying capacity of the pipe, assumed for the economic design period. By providing for a greater maintained carrying capacity through the use of interior lining throughout the system, it is possible to use pipes of smaller diameters and thus lessen the cost. Pipes centrifugally cast or spun with a bituminous lining have given excellent service with savings in the distribution system. The bituminous enamel is a solid material manufactured from a purified coal tar base and other ingredients, such as gums and fillers. It is melted to a liquid consistency and applied at a temperature of 400° F. to 415° F. The material sets in less than one minute. CBJ (32)

Explosions in Drying Ovens; Spontaneous Ignition of Vapors of Solvents (Explosionen in Lacktrocknungsöfen; Selbstentzündung von Lösungsmitteldämpfen). FREITAG. *Oberflächentechnik,* Vol. 8, Oct. 20, 1931, page 217.

The solvents for varnishes, lacquers, paints, etc., used in the metal industry are often the cause of explosions in the drying ovens because of the evaporation of the solvents and their coming into contact with the over-heated metals of the oven, itself. The ignition temperatures vary according to whether the vapors come in contact with metal or with glass. For the following frequently used solvents, the respective inflammation points are:

Solvent	With Glass	With Steel
Aceton	633° C.	649° C.
Benzol	580° C.	649° C.
Butylalcohol	356° C.	349° C.
Ethylether	188° C.	193° C.
Alcohol	421° C.	392° C.
Methanol (Methylalcohol)	475° C.	474° C.
Isopropylalcohol	457° C.	634° C.
Oil of turpentine	252° C.	262° C.
Toluol	553° C.	—

Ha (32)

Paint Coatings on Ships (Betrachtungen über Schiffsanstrich). M. RAGG. *Korrosion und Metallschutz,* Vol. 7, July 1931, pages 158-163.

The 2 problems involved in paint-coatings for maritime uses below the water-level are stressed: (1) rust protection, (2) anti-fouling means. An exhaustive information of the author's experience gained over a long period of years is given and refers to laboratory tests as well as to observations under actual service conditions. The numerous poisons applied and their usually negative effect are discussed. The nature of the various organisms found at the ship's bottom are considered at length. The author arrives at the conclusion that the inorganic Cu and Hg-compounds which have long been utilized could not yet be advantageously substituted in spite of the fact that the pre-war price of the latter increased 50% and 300%, respectively. The paper was presented at the General Meeting of the Reichsausschuss für Metallschutz, Kiel, 1930. EF (32)

Paint Sections and Surface Protection by Painting (Farbquerschnitte und Oberflächenschutz durch Anstriche). M. WILLMER. *Oberflächentechnik,* Vol. 8, Aug. 4, 1931, pages 161-163.

In order to discover the constitution of a coat of paint, a section is made through the whole layer of filler, ground color and top layer. This section is examined under the microscope. These investigations have shown that the surface of a good lacquer or varnish must be able to show a thin, clear film with a high polish. Nitro-lacs, especially, possess this quality; if it is destroyed by weather influences, they can again be polished with a suitable polishing agent. The thickness of the coat of paint, alone, does not assure its good quality. Several photographs illustrate these points. Ha (32)

What Should a Foundry Man Know of Enameling of Cast Iron (Was muss ein Giessereifachmann von der Gussemaillierung wissen)? JOH. WISSER. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Aug. 28, 1931, pages 686-688.

The author describes the preparation and application of the enamel and the treatment of castings for obtaining a perfect enamel coating. He also discusses the possibilities of failures and their causes and elimination. The expansion coefficient is of great importance; it should be, as nearly as possible, the same for the cast iron and the enamel. A good composition for cast iron which is to be enamelled is given as containing up to 3.5% C, 2.2-2.5% Si, 0.5-0.9% P, 0.6-0.9% Mn and not more than 0.1% S. The design of a piece also has an influence since greatly varying sections prevent uniform melting of the enamels. Ha (32)

Enameling Mechanized on Counter-Flow Principle. W. O. OWEN (Surface Combustion Corp.). *Iron Age,* Vol. 128, July 2, 1931, pages 16-17, 53-54.

Describes installation at the plant of the Peerless Enamel Products Co., Belleville, Ill. The plant operates on a mass production basis. The layout involves duplicate runs through the furnace with heat interchange between cold incoming and hot outgoing parts. Heat is saved and handling is facilitated by the arrangement of furnace dryers, dip tanks and spray booths. VSP (32)

Decorating the Surfaces of Precious Metals with Enamel. J. W. WOLFE. *Metal Cleaning & Finishing,* Vol. 2, Nov. 1930, pages 981-984.

Outline of the history and application of decorative enamels. Au is the best metal for this purpose. The purer the Au, the less are the chances of failure of the enamel. Presence of an oxidizable element such as Ag or Cu is likely to lead to reactions between the enamel and these metals. Transparent, translucent, opaque enamels are the types used. Hard enamels are preferable although more difficult of treatment. Gives formulas for producing various colors. MS (32)

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

301 **Metal Testing**—Several metal testing devices are discussed in a folder prepared by Riehle Bros. Testing Machine Co., Philadelphia, Pa. They are: A precision hydraulic universal testing machine, a Vickers pyramid hardness tester, a Brinell tester and the Spekker steeloscope. A special booklet devoted to any of these machines may be procured from the company.

302 **Dowmetal**—This is the name which identifies magnesium alloys developed and manufactured by the Dow Chemical Company, Midland, Mich., and they have recently sent out a small booklet which gives the properties and applications of these alloys.

303 **Alloy Steel Castings**—An attractive pamphlet prepared by the Duriron Co., Inc., Dayton, Ohio, sets forth the physical properties of their "Durimet" and "Durco Nirosta" together with their chemical analyses. A table of their resistance to various chemicals is included.

304 **Foundry Equipment**—The February issue of "Better Methods," published by Beardsley & Piper Co., Chicago, Ill., contains several interesting articles and a description of their new "Screenarator" for screening, aerating, mixing, blending and piling sand.

305 **Corrosion Resisting Alloys**—The Associated Alloy Steel Co., Inc., Cleveland, Ohio, is distributing samples of their "Nevastain RA," a steel alloyed with chromium, copper and silicon which is said to have excellent corrosion resistance together with unusual machining, drawing and forming properties.

306 **Metal Cleaning**—Instructions for using Yellow Label Annite, a special detergent for cleaning non-ferrous metals, have been sent out recently by the Quigley Co., Inc., New York. There are several brands of Annite, and the uses of each of them are given in the same booklet. This company has also issued a leaflet describing their "Q-Seal," a plastic expansive joint sealing compound for all industrial uses.

307 **Quenching**—E. F. Houghton & Co., Philadelphia, Pa., have compiled an 80-page booklet which explains in simple terms the structural changes that take place as the result of various heat treatments. It contains over 30 charts and photomicrographs and presents the results of many years of research on the structure developed by quenching.

308 **Arc Welding**—A leaflet describing their simplified arc welder with "Unitrol Dial" has been sent out by the Hobart Brothers, Troy, Ohio. Various types of the machines are illustrated.

309 **Burners**—A folder, punched for filing, describing industrial burners has been issued by The C. M. Kemp Mfg. Co., 405 Oliver St., Baltimore, Md. Cross section diagrams of their various types of burners and their fire checks are given. A folder discussing their carburetors is also available.

310 **Cutting Metals**—Ramet (tantalum carbide) closely approaches the diamond in hardness, has a tensile strength of 250,000 lbs./in.^{2} and withstands shock and impact remarkably well and can be ground to a fine cutting edge. The Fansteel Products Co., North Chicago, Ill., has issued an attractive leaflet describing this product which is offered in a wide range of styles and sizes which will be found adaptable to most turning operations.

311 **Strain Gage**—The Tuckerman optical strain gage for the precise measurement of tension and compression strains in hot and cold metal specimens and for the testing of riveted joints is discussed in a pamphlet sent out by the American Instrument Co., Inc., Washington, D. C.

312 **Grinding**—The December issue of "Grits and Grinds," published by the Norton Company, Worcester, Mass., contains a description of a radial truing device, an aid in producing accurate work. Another interesting article in this issue is entitled "Mirror Finish on Rolls."

313 **Aluminum Alloys**—A most attractive 63-page book prepared by the Aluminum Company of America, Pittsburgh, Pa., gives in concise form information concerning the physical and chemical properties of the aluminum alloys produced by them. It also contains tables showing the sizes of the basic commodities the company manufactures from these alloys.

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ALPHABETICAL INDEX TO ADVERTISERS

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Joseph T. Ryerson & Son, Inc. have announced that the management of their St. Louis Plant has been taken over by **Harold B. Ressler**, Vice-President at Chicago. Mr. Ressler, who was formerly the St. Louis Plant Manager for 15 years, will be in direct contact with the St. Louis organization, making regular visits to the plant and St. Louis territory.

In Mr. Ressler's absence, **R. B. Wilson**, Manager of Sales of the Ryerson St. Louis Plant, will be the senior resident executive. Mr. Wilson, has been associated with the St. Louis organization for over 17 years.

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Lindeweld Process Shown in Motion Pictures

The technique of the Lindeweld Process and its application in the construction of a 20-in. natural gas line are shown in full detail in a motion picture, "New Lindeweld Process for Pipe Line Construction," prepared and distributed by The Linde Air Products Company, New York, N. Y.

Contact Potential Difference between Iron and Nickel and their Photoelectric Work Functions. G. Norris Glasoe. *Physical Review,* Vol. 38, Oct. 1931, pages 1490-1496.
Specimens of electrolytic Fe and electrolytic Ni were outgassed by intensive heat treatment in high vacuum and the contact potential difference between them measured by the Kelvin null method. An apparatus is described by means of which the photoelectric long wave limits could be determined on the same specimens and under identical conditions as used for the contact potential measurements. The photoelectric long wave limits were determined in one case by using filters in the path of the light and in the second case by the method of plotting the photoelectric sensitivity curves obtained using monochromatic illumination of the metals. The results remained unchanged between 300 and 750 hrs. of heating in the first case and between 400 and 600 hrs. in the second. The equilibrium value of the contact potential difference was Fe-Ni = 0.21 ± 0.01 volt. The photoelectric long wave limits determined by the second method were 2620 A.U. ± 10A.U. for the Fe and 2500A.U. ± 10A.U. for the Ni. The corresponding work functions are 4.71 ± 0.02 volts for the Fe and 4.93 ± 0.02 volts for the Ni. Using the method published by Fowler the work functions were 4.77 volts for Fe and 5.01 volts for Ni. The difference in these work functions by either method is equal to the measured contact potential difference between the metals within the limits of error of the photoelectric measurements. WAT (1)

Change of Weight of Metals under Compression. V. Some New Experiments in Gravitation. C. F. Brush. *Proceedings American Philosophy Society,* Vol. 64, 1925, pages 36-50.
Cylindrical metal test pieces machined from castings very slowly cooled, are fitted in a screw compression device and the whole is counterbalanced by a similar device suspended from the other arm of a carefully shielded balance. Successive compressions are then applied to one specimen, and an increasing loss of weight is noted which is partly regained on release of pressure so long as the elastic limit of the material is not exceeded. For Al and some alloys the effect is pronounced, the loss being of the order of 1 in 50,000. The author considers that corrections for buoyancy are unnecessary, since the counterpoise is accurately of the same nature as the apparatus being weighed. The theory that the results are explained by the expulsion of occluded gases is considered untenable. Ha (1)

Bismuth. *Metallurgist,* Dec. 1930, pages 191-192.
A comprehensive review covering metallurgy, physical properties, uses and applications and the extrusion of bismuth wire. VVK (1)

The Zero Point of the Charge of Silver (Ueber den Nullpunkt der Ladung von Silber). M. Proskurnin & A. Frumkin (Karpow Inst. of Chem. Moskau). *Zeitschrift für physikalische Chemie,* Sec. A, Vol. 155, No. 1, June 1931, pages 29-40.
Two methods employed aimed at the determination of the adsorption effects originated at the contact between a degasified silver surface and an aqueous solution. The zero point of the charge of a pickled silver surface yielded ϵ_h = 0.51, which value is in fair agreement with previous determinations of other investigators. EF (1)

Metallography and Properties of Metals. Rare Metals and Possibilities of their Use in the Metal Industry (Metallographie und Eigenschaften der Metalle. Seltene Metalle und ihre Verwendungsmöglichkeiten in der Metallwirtschaft). *Metallwirtschaft,* Vol. 10, Mar. 6, 1931, page 190; Mar. 13, page 209; Mar. 20, page 227.
Gallium is found in small percentages in numerous minerals, especially in zinc blende in Oklahoma. In the Joplin district 80-140 g./ton of ore are found. It melts at 30° C. and boils at over 2000° C. Its use for high temperature thermometers in quartz glass is being developed. To prevent it from sticking to the quartz, oxides and impurities must be removed by treating with warm dilute HCl. Other possible uses are for optical mirrors and alloyed with Al for cathodes for metallic vapor lamps. *Germanium.* This element lies between Si and Zn in the periodic system. Its melting point is 910° C. and hardness 6.25 on Moh's scale. It resists acids and alkalies and is brittle similar to Si, but otherwise resembles Zn. It occurs in 5-7% in Argyrodite but is more cheaply obtained from Enargite. The dioxide has been used to some extent in medicine. 1.2-1.6% Ge in Al alloys such as duralumin increases the tensile strength and rolling properties. Glass made with GeO_2 instead of SiO_2 has greater strength and can be poured at lower temperatures. The high price of Ge, about $10 a g., prevents its further use. *Scandium* is one of the rarest elements and not much is known of its properties. It is similar in some respects to the rare earths, in others to the Fe group. It melts at about 1200° and boils at 2400° C. *Indium* melts at 155° and boils at 1450° C. It can be obtained electrolytically, is readily soluble in HNO_3, less in HCl and H_2SO_4. Small percentages are found in zinc blende and other minerals, usually with Ga and Ge. A bearing metal containing 0.5-3.5% In has been patented. *Titanium* occurs in large quantities in the earth's crust, but has become important only in the last 10-15 yrs. It melts at 1800-1850° and is hard enough to scratch quartz. It is brittle at room temperature, but can be forged and drawn at red heat. It combines directly with most non-metals under heat and forms alloys with many metals. It is recovered from rutile, TiO_2, and ilmenite, $FeO.TiO_2$. Ti is used mostly as TiO_2 in white paint pigments. It has greater resistance to chemicals, covering power and durability. TiO_2 is also used in ceramics, for artificial teeth, and as a quick setting cement. Ferro-titanium containing 15-18% Ti and 7.5% C is made in the electric furnace. C-free ferro titanium is made by the thermit process. It contains 25% Ti and 5% Al and is more expensive than that containing C. They are used for the production of special steels. Ti-Cu containing 10% Ti and Ti-Mn containing 30% Ti are on the market and are used in small quantities for the deoxidation of brass, bronze, Ni and Cr alloys. Konel, an alloy of Fe-Ti, Co and Ni, is supposed to retain its strength at high temperatures and is used as a substitute for Pt in radio tubes. CEM (1)

Batterium Metal—a New British Anti-Corrosive Material. *Chemical Trade Journal,* Vol. 89, July 3, 1931, pages 5-6.
Batterium metal is manufactured by Batterium Metal & Voslok, Ltd. of Market Harborough, England, and was developed by the Research Department of the Tungstone High-Pressure Die Casting Co., Ltd. It is used as plate terminals of Tungstone car batteries and in the manufacture of the Tungstone pump. It is a natural alloy containing 89% Cu, 9% Al, and 2% Ni and other metals in specific proportions. It contains no Pb, Sn, Zn, or Sb. It possesses a silvery gold color. Its physical, chemical and electrical properties are indicated. A table shows the action of acetic, sulphuric and hydrochloric acids of various strengths, and of several sodium salts in hot and in cold solutions. WHB (2)

Carbobronze Tubing. *Industrial Chemist,* Vol. 7, June 1931, page 257.
Carbobronze (alloy containing about 92% Cu, 8% Sn and 0.3% P) is of dense structure and possesses great homogeneity. A strong resistance to the action of a wide range of acids and alkalies is claimed. RAW (2)

Bronze and Red Brass (Bronze und Rotguss). VDI-Verlag GMBH, Berlin NW 7, 1931. Paper, 6x8¼, 100 pages. Price 7RM.
The German standards (given in the appendix) for this class of castings include 10 alloys, but do not include 85-5-5-5, 88-10-2 nor 80-10-10, the alloys approaching these being 82 Cu, 8 Sn, 7 Zn, 3 Pb; and 85 Cu, 5 Sn, 7 Zn, 3Pb; 86 Cu, 10 Sn, 4 Zn; and 80 Cu, 8 Sn, 12 Pb.
Short articles by Schmidt, Schwietzke, Reiff, Krekeler, Reitmeister, Fiek, Vierhaus, Riccius, Melchior, Schulz, Hennings, Bay and Claus are given, with discussion. Starting with the Cu-Sn equilibrium diagram, the structure of various compositions at various cooling rates is discussed, then the influence of the addition of Zn.
A questionnaire to 70 German firms in 1930 brought out the fact that 29 paid practically no attention to the standards, and while 15 of the firms make 60% of their production in the standard alloys, of the whole 70, only 20% of the output is according to the specifications.
It was pointed out that the specification limits as to impurities, especially Pb and Sb, made it difficult to use secondary ingot for some of the compositions and live up to the specifications.
Several comments in the discussion indicated that the alloy 82 Cu, 8 Sn, 7 Zn, 3 Pb was little used, and might be eliminated from the standards.
The machinability of the alloys and the use of cutting oils and emulsions were discussed, as were the effects of oxides, S and of over-reduction.
Melchior advocates the use of Be as a deoxidizer for copper castings when high electrical conductivity is desired. Bay reports materially improved properties on annealing the alloy of 86 Cu, 14 Sn.
Many interesting comments were brought out in the general discussion whose reproduction here would extend this abstract too far. Non-ferrous foundrymen will find the whole pamphlet of interest. H. W. Gillett-B-(2)

Special Complex Brasses (Les laitons complexes). Leon Guillet. *Cuivre et Laiton,* Vol. 4, Nov. 15, 1931, pages 501-503.
Several types of brasses and bronzes are described. The addition of Al and Si together should be avoided; Al and Mn together do not develop any better quality than one of these elements, alone, can produce. The presence of Ni produces very good effects in complex brasses; for example, the following composition shows very good mechanical properties: Cu 58%, Zn 31.15%, Ni 7.45%, Al 3.4%. It can be forged readily; it is not difficult to pour; it has as high resistance to corrosion as any good alloy known. The resistance to repeated impacts is somewhat higher than that of mild annealed steel. Heat treatment does not give a noticeable improvement; these alloys can be used as they are cast. They are easily machined. Ha (2)

The Electric Conductivity of the Gold-Nickel Alloys (Die elektrische Leitfähigkeit der Gold-Nickellegierungen). G. Grube & F. Vaupel. *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 187-197.
Temperature-resistance curves were plotted over the temperature range from 20° to 900° C. with the object of investigating the reactions associated with the decomposition of the homogeneous solid solutions of the Au-Ni alloys. The conclusion is drawn from the data obtained that the homogeneous solid solution decomposes into a heterogeneous mixture of solid solutions one kind of which is rich in Au and another which is rich in Ni. The decomposition is caused by the decrease in solubility of the components at falling temperatures. The boundary line separating the field of homogeneity from that of heterogeneity is established and presented in a diagram. No indication of 2 eutectoid horizontals assumed by Heike and Hafner (Doctor's thesis, Freiberg, and *Zeitschrift für anorganische Chemie,* Vol. 182, 1929, page 272) was found whereas the results are in fair agreement with the findings of Fraenkel and Stern (*Zeitschrift für anorganische Chemie,* Vol. 151, 1926, page 105; Vol. 166, 1927, page 161). EF (2)

Copper Alloys Containing Silicon. *Chemical Age,* London, Vol. 22, Jan. 4, 1930, Metallurgical Section, pages 1-2.
A review of 11 references. VVK (2)

Everdur and Tempaloy. W. H. Bassett. *American Metal Market,* Vol. 33, July 2, 1931, page 2.
2 kinds of hardened copper, the former varying from 94.8% Cu, 4% Si and 1.2% Mn for castings to 96.0% Cu, 3% Si and 1% Mn for wrought forms and castings. Everdur can be forged and rolled hot but will not stand much cold working. Excellent corrosion resistant material. Tempaloy is copper carrying nickel silicide; when heated to 800° C. and chilled, it is soft and ductile, and can readily be cold worked. It may be age hardened when alloy is held at 450° C. for a few hours; without cold working, or after cold working, addition of Al strengthens Tempaloy and increases its hardening properties. DTR (2)

PROPERTIES OF FERROUS ALLOYS (3)

Non-Magnetic Cast Iron (Nichtmagnetisches Gusseisen). *Elektrotechnische Zeitschrift,* Vol. 52, May 7, 1931, page 612; *Revue de Fonderie Moderne,* Vol. 22, Sept. 25, 1928, page 378.

This material called "Nomag" is made by the Ferranti Works, Hollinwood, Lancashire, England and has the following characteristics:

	Highest magnetic permeability	Spec. resistance $\mu\Omega/cm.^2$
Ordinary cast iron	330.00	95.00
Brass	1.00	7.50
Nomag iron	1.03	140.00

The material is ,therefore, particularly suitable for resistance grids. It is as easily cast as cast iron and can be Ni, Cu or Cr plated. It is, also, just as easily machinable and can be welded. Ha (3)

On the Properties and Utilization of Ni and Cr-Ni Steels (Ueber die Eigenschaften und die Verwendung der Nickelstähle und Chrom-Nickelstähle). J. Galibourg. *Korrosion und Metallschutz,* Vol. 6, Sept. 1930, page 206.

Brief reference to the paper read at the International Congress of Mining, Metallurgy and Applied Geology, Liege, 1930. See also *Metals & Alloys,* Vol. 2, Aug. 1931, page 141. E F (3)

Physical and Chemical Limitations for Ferrous Castings in the Latest A.S.T.M. Specifications. *Research Group News,* Vol. 8, Oct. 1931, pages 429-433.

The standard specifications for steel castings A27-24; for C steel castings for valves, flanges and fittings for high temperature service A95-29; for C steel castings for railroads A87-27; for high-test gray iron castings A88-31; gray iron castings A48-29; cast-iron locomotive cylinders A45-14; cast iron soil pipe and fittings, A74-29; cast iron pipe and special castings A-44-04; gray iron castings for valves, flanges and pipe fittings A126-30. A few tentative specifications are also reprinted in detail. Ha (3)

Magnetic Properties of Some Nickel-Iron Alloys. *Metallurgia,* Vol. 5, Nov. 1931, pages 1-3.

Bibliography of 17 references. Attention is called to the wide range of magnetic properties that can be secured in Fe-Ni alloys. Those containing about 78% Ni have a very high initial permeability and a high permeability at low magnetizing fields. The properties can be modified by other elements such as Cu, Mo, Cr and Co. Some alloys containing Co (Perminvar) have an almost constant permeability over a rather wide range of magnetizing forces and a very low hysteresis loss. JLG (3)

Wear Resistance of Cast Iron (Verschleissfestigkeit des Gusseisens). *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Oct. Oct. 10, 1931, page 1274.

A testing arrangement is described by means of which the wear of high grade cast iron is tested, as dependent on hardness, on additions of C, Si, Mn, P, S, Ni, Cr and Cr-Ni, on temperature and quality of surface. Not the absolute hardness, but the difference in hardness of the 2 materials working on each other, determines the wear. The wear is least when this difference becomes zero. A strict dependence on the absolute hardness can be stated only if both moving and stationary parts have the same hardness. The wear is determined to a certain extent also by the formation of graphite. Long, thin graphite veins reduce wear; coarse, thick veins and graphite eutectic increase wear. A content of P up to 1% increases the wear strength considerably; beyond that, but little. With increasing temperature, the wear depends greatly on the P content. The quality of the surface is of greater importance, the higher is the grade of cast iron. Very hard surfaces have to be smoothed by machining. Ha (3)

Wrought-Iron Pipe Nipples. *Commercial Standard CS 6-31, U. S. Department of Commerce, Bureau of Standards,* 1931, 14 pages.

A revision of the former standard of 1929. Pipe from which nipples are made must conform to A.S.T.M. Standard A72-30. Details of dimensions and threads and lists of stock sizes and lengths of standard weight and extra strong nipples are given. HWG (3)

Kanthal, Ltd., Hallsthamar, Sweden (Aktiebolaget Kanthal Hallsthamar). *Journal du Four Electrique,* Vol. 40, June 1931, page 241.

Kanthal is an electric-resistance alloy with an iron base and melting point of 1650° C. Its specific gravity is 7.2. The metal is suitable for use at temperatures near 1300° C., but the point of decomposition of its better grades was not reached at 1350° C. After heating for 800 hrs. at 1250° C. the metal has the same silvery gray appearance as before the experiment. Its heat-resistance both at high and low temperature is much better than that of 80% Ni and 20% Cr alloy. Several furnaces for quenching high speed steel have already been installed in Sweden and, after considerable use, show that the heating elements did not deteriorate. The metal is easily machinable. About a dozen installations of heat recuperators on oil burning furnaces have been in use for more than a year. A carburizing box in a continuous use at 950° C. was in a perfect shape after 2 years' use. The resistance to SO_2 gas is very good at all temperatures. Several grades depending on the heat resisting requirements are manufactured. JDG (3)

Alloy Steel Castings. *Vancoram Review,* Vol. 2, July 1931, pages 83-86.

A few of the recently developed V steels with Ni additions are discussed. Some with Mo and Cr which show very high elastic properties, resistance to wear and ability to render long continued service when exposed to loads suddenly applied are particularly discussed; the C content is between 0.2 and 0.3%. A series of V cast steels which combine high yield point, high tensile strength and high impact resistance are also described. For the various analyses and test results, the paper must be referred to. Ha (3)

CORROSION, EROSION, OXIDATION, PASSIVITY AND PROTECTION OF METALS & ALLOYS (4)

Corrosion of Metals under the Influence of Various Liquid Fuels (Korrosion von Metallen unter der Einwirkung von verschiedenen flüssigen Brennstoffen). *Automobiltechnische Zeitschrift,* Vol. 34, June 10, 1931, pages 384-385.

A review of literature giving information on this subject. Benzene, as used in airplanes, has a corroding influence on Pb; other metals were not attacked and the benzene remained unchanged. Pure benzol, toluol and xylol do not attack; metals immersed in them receive deposits of a tar-like substance. Pb was corroded by alcohol; metals immersed in alcohol were not attacked but, if exposed to the vapors, were strongly attacked. Commercial alcohol attacked all metals; likewise, methyl alcohol. The nature of the deposits is described and the loss of material in mg./dm.^{2} surface is tabulated for all the fuels investigated. Ha (4)

Broken Rivets Indicate Caustic Embrittlement. *Boiler Maker,* Vol. 31, Feb., 1931, pages 45-46.

If the quantities of soda ash and lime for treating the feed water are not regulated in keeping with the nature of the water, the danger exists that an excess will be present, and rivets become brittle. Several cases in which this was the obvious cause are noted. Ha (4)

Prevention of Boiler Corrosion in Storage. *Boiler Maker,* Vol. 31, April, 1931, pages 92-94.

Abstract of the report on protection of boilers and boiler materials from corrosion and deterioration while in storage. Best methods are recommended; racks, sheds, oiling, etc., are discussed. Ha (4)

Methods for Determining the Corrosion Resistance of Aluminium and Aluminium Alloys. *Industrial Chemist,* Vol. 7, Sept. 1931, pages 378-380.

A translation of the "Tentative Standards elaborated by the Aluminum Board of the German Reichsausschuss für Metallschutz." The article describes the taking of the specimen from the sample sheet, number, size, and preliminary treatment of the specimens, as well as discussing the evaluation of the results. Special directions for the performance of the tests and the use of an apparatus for corrosion tests in stirred solutions are given. RAW (4)

Results of Questionnaire to the Chemical Industry Concerning Experience with Aluminum Applications (Material-Prüfungs-und Untersuchungswesen Nachtrag Nr. 7 zum Ergebnis der Rundfrage bei den chemischen Fabriken über Erfahrungen mit Aluminium-Verwendung). *Apparatebau,* Vol. 41, Sept. 6, 1929, pages 205-208; Sept. 20, 1929, pages 220-222.

A report of the corrosive action of several chemicals on Al. Reports are given for (1) aceticanhydride, (2) caustic soda, fortified with bichromate, (3) ammonium nitrate, (4) ammonium sulphate, (5) acetic acid, (6) honey, (7) O, and several other conditions with varying acidity and alkalinity. WHB (4)

Corrosion Resistant Alloys of the Stainless Type. T. Holland Nelson, *Heat Treating & Forging,* Vol. 17, June, 1931, pages 563-568; July, 1931, pages 679-683; Aug., 1931, pages 773-775.

The author deals with that phase of the use of stainless steels which lies between the product as finished steel by the manufacturer and the ultimate finished fabricated structure called for by the user. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 246. Ha (4)

Deterioration of Structures in Sea. *Canadian Engineer,* Vol. 59, Oct. 28, 1930, pages 593-594.

An extended abstract of the Tenth Interim Report of the Institute of Civil Engineers. VVK (4

The Protection of Ironwork in Buildings. *Chemical Age, London,* Vol. 22, March 22, 1930, pages 266-267.

A discussion by Mr. Arthur J. Castle of the Borough Polytechnic Oil & Colour Students Association and Mr. J. N. Tervet of the Oil and Colour Chemists' Association on protective coatings at a joint meeting of the 2 societies. VVK (4)

Zinc and Cadmium for Preventing Corrosion. L. K. Wright. *Machinery,* Vol. 37, Jan., 1931, page 343.

A comparison of the fields of application of the 2 metals and general directions for the selection of the one to use for a certain purpose. Ha. (4)

Rustless Steels—Their Fabrication and Use. T. Holland Nelson. *Iron Age,* Vol. 127, June 11, 1931, pages 1908-1912.

Includes discussion. Abstract of paper read at the May meeting of the American Iron & Steel Institute. See "Corrosion Resistant Alloys of the Stainless Type in Use and Fabrication." *Metals & Alloys,* Vol. 2, Nov. 1931, page 246. VSP (4)

Corrosion of Power Plant Equipment. *National Engineer,* Vol. 35, Sept., 1931, page 296.

A study was made to discover what factors usually contribute to the corroding effects of flue gases. It is stated that corrosion is most often present when the S content of the coal exceeds 2%. Corrosion in pulverized fuel systems is never severe, even when the same fuel produces corrosion when fired on a stoker. High ash coals, especially under high draft, produce corrosion in most cases. The zone of maximum corrosion is usually that immediately in front of the air intake on the air preheater. The highest metal temperature at which severe corrosion is encountered is about 300° F. Above this temperature, the slight corrosion is similar in extent and type to that which takes place in ordinary boiler tubes. Differences in type of construction of economizers and preheaters do not show great differences in the rate of corrosion. Protective metallic coatings have not withstood the attack. Enameled tubes will withstand corrosion if mechanical difficulties connected with their use can be eliminated. Ha (4)

Corrosion of Metals by Food Products. *Chemical Age, London,* Vol. 25, July 11, 1931, page 36.

A valuable compilation of existing data on the use of metals and alloys in contact with dairy products has been issued by the Kollegium der Preussischen Versuche- und Forschungsanstalt für Milchwirtschaft (*Milchwirtschaftlicher Literaturbericht,* No. 36, 1930, page 181). VVK (4)

Corrosion of Lead-Sheathed Cables (Beitrag zur Korrosion von Bleikabeln). G. GARRE. *Elektrotechnische Zeitschrift,* Vol. 52, Nov. 12, 1931, page 1418.

After 16 yrs., a failure occurred in a cable with pure Pb cover which contains only traces of Sb. A careful investigation showed the cause of the corrosion to be the effect and the presence of phenol in the impregnated paper insulation of the cable. Ha (4)

Conference on Exposure Tests of Plated Coatings. *Monthly Review American Electroplaters' Society,* Vol. 18, April 1931, pages 8-16.

This conference was to discuss a program for exposure tests on electroplated coatings which is to be carried out through the co-operation of the American Electroplaters' Society, the American Society for Testing Materials, the Bureau of Standards and the manufacturers interested. The 2 principal purposes of the investigation are (1) to determine the relative value for protection against corrosion of electroplated coatings of known composition, thickness and preparation; (2) to determine the relation of laboratory tests on such coatings to their protective value under different conditions of service. The tests to be made should include (1) accelerated corrosion tests; (2) porosity tests; (3) stripping tests; (4) adhesion tests; (5) exposure to corrosion while stressed. The order of tests, solutions and conditions to be used in plating, size, shape and arrangement of the specimens, preparation for plating, conditions of exposure, methods of inspection are described in detail. Ha (4)

Stainless Metals. HAROLD CARPENTER. *Iron & Coal Trades Review,* Vol. 122, May 1, 1931, pages 690-691.

A general review of corrosion phenomena, their causes and elimination, particularly in iron and steel by the addition of Cr; the effects of composition and heat treatment and the types of stainless steels now produced. Ha (4)

Corrosion Phenomena Observed on Copper-bearing Steels with Particular Reference to the Attack by Sea-Water (Der Korrosionsvorgang beim gekupferten Stahl unter besonderer Berücksichtigung des Angriffes durch Seewasser). C. CARIUS (Res. Lab. of Vereinigte Stahlwerke, Dortmund). *Korrosion und Metallschutz,* Vol. 7, Aug. 1931, pages 181-191. Includes discussion.

A lecture delivered before the Reichsausschuss für Metallschutz, Kiel, adding some further findings to statements previously published (See *Metals & Alloys,* Vol. 2, July 1931, page 127). The beneficial influence of Cu upon the corrosion resistance against atmospheric attack of low alloyed steels is summarized in the introduction. Although being contradictory, corrosion tests in liquid media did not yield the same marked advantages due to an addition of Cu. The various stages of the rusting process on copper-bearing steels (0.2-0.3% Cu) in distilled water is characterized by the formation of a dense Cu-film, which slowly oxidizes, flakes off and is again originated, thus retarding the corrosion speed of the same steel free from Cu. Entirely different conditions are met with in alkaline or salt solutions, mainly due to a spongy precipitation of the Cu. The potential of finely dispersed, atomic copper is assumed to be considerably less noble than the potential of Cu in crystalline form. The complicated reactions in aqueous salt solutions are traced in 2 set of samples (a) with access to air, (b) in sealed containers. The author arrives at the conclusion that a "sorption compound" consisting of Fe_2O_3 aq- and the basic Fe $(OH)_2+$ is formed. The varying amounts of Fe_2O_3 are responsible for the gradually changing colors of this compound. It might be mentioned that an experimental steel was melted which contained 0.2% Al instead of Cu to throw light upon the role played by the latter metal. The result of commercial significance is that the analysis of the copper-bearing steel was modified by a further addition of 0.11% Al to the 0.2% Cu, which is supposed to result in a fair corrosion stability in salt water, also. EF (4)

Standards for Corrosion Tests on Aluminum. Correspondence from GEORG GOLDBACH, Berlin, Germany. *Metal Progress,* Vol. 20, Oct. 1931, pages 91, 92, 120.

The writer describes test apparatus and method for corrosion tests on Al. WLC (4)

The New Immersion Method of the Research Institute Gmuend for the Protection of Silver and Silver-Plated Wares Against Tarnishing (Das neue Tauchverfahren des Forschungsinstituts Gmünd zum Schutze von Silver-und versilberten Waren gegen das Anlaufen; D. R. P. angemeldet). *Oberflächentechnik,* Vol. 8, Oct. 6, 1931, pages 207-208.

After long years of experimenting, a solution has been found which will entirely prevent tarnishing of any ware immersed in it. It can be cleaned, as is usual in the household, without being rubbed off. The nature of the solution is not disclosed. Ha (4)

Nickel and its Alloys in the Decorative Arts (Le nickel et ses alliages dans la décoration). *L'Usine,* Vol. 40, Sept. 18, 1931, page 27.

A brief enumeration of the alloys containing Ni which are used, either directly for the manufacture of decorative articles which must not rust, or as a rust-proof coating. Ha (4)

Grounding and Corrosion of Metals. (Erdungsfrage und Metallkorrosion). *Metallwirtschaft,* Vol. 10, May 15, 1931, pages 393-394.

Contribution from the German Copper Institute. Contains 4 references. Telephone lines and radios are frequently grounded on water or gas lines to overcome interference from weak electric currents. Grounding has often been blamed for corrosion of metals, but investigation has always proved that other factors are responsible. S in gas may be the cause of Cu water heaters corroding. For water lines, Cu is the only practical metal which does not corrode. Pb water pipes through which hot and cold water flows alternately may break due to change in crystal structure if the Pb is not pure. If Fe pipe is in contact with brass, Pb or Cu, electrolytic currents of measurable size are produced which may be as high as 1 amp./m.[2] or higher with warm water. CEM (4)

High Steam Temperatures and Steel. *Metallurgist*, June 1931, pages 86-87.

This article is primarily an extended abstract of an investigation by Munzinger (*A. E. G. Mitteilungen*, Jan. 1930, *Das Kraftwerk*, page 26) on the cause of failure of superheater tubes with a brief summary of the work of Fellows (*Power*, page 258, 1929). The instigation of Munzinger's work was the failure of a number of superheater tubes in a boiler plant operating at 320 lbs./in.^{2} steam pressure at a temperature of 425° C. The superheater had proved to be entirely too large for the purpose and after repeated removals for covering was finally operating at about 60 to 70% of its original capacity. After about 4 months' operation under various burdens, a number of tubes were burnt through. There was a fairly large deposit of iron oxide inside the tubes and the outside was more or less oxidized. Opposite to a blister, a horn shaped very solid deposit consisting of chloride and soda had formed. In some places the tubes were almost completely eaten away by internal corrosion, whereas places not attacked showed no diminution in strength. The corrosion on the inside of the tubes was more severe than on the flue gas side. It was considered improbable that the corrosion was caused by the dissociation of water vapor. As the heating surface of the superheater was too large, there was probably unequal attack on the individual coils, and the deposition of impurities carried over into the superheater caused a decrease of clear cross section which resulted in a higher temperature in some tubes than that measured at the superheater outlet. A reaction between the steam and tube thus resulted and was increased by the presence of chlorine compounds carried over with the steam. The A. E. G. Research Institute investigated the formation of the oxide layer at higher temperatures. A spiral of iron wire was heated in a silica tube and a stream of water vapor was passed through the tube. The progress of the oxidation of the wire was determined by measuring the electrical resistance, which increases as oxidation proceeds. The reliability of this method was tested by careful preliminary experiments, and results were confirmed by comparison with the increase in weight due to the formation of oxide. The results indicate that, after reaching an approximately constant rate, the rate of oxidation at 610° C. is about 5 times that at 500° C., and after about 360 min. at 500° C. there is scarcely any further increase in resistance, while the increase at 610° C. is still very pronounced. This is regarded as indicating that at the lower temperature a protective oxide layer is formed after a certain time, but at the higher temperature the formation of a protective layer is improbable. This result suggests that, in ordinary mild steel tubes, there is a critical temperature in the neighborhood of 500° C. above which the steel is rapidly attacked although feed water conditions are normal and attack by the hot flue gases is not appreciable. It is possible that free O in the feed water may contribute to the damage to the boiler, but the experiments indicate that, even with gas-free feed water, strong corrosion can proceed. Tests were also made on the mode and magnitude of attack by alkali and chloride carried over with the steam into the superheater. It is considered, however, owing to the varying conditions, that it is difficult to forecast the effects in the superheater from laboratory experiments, but it is extremely probable that alkali and chlorides considerably accelerate corrosion. The amount of corrosion observed in laboratory experiments may, under practical conditions, be increased by vibration of the superheater coils, temperature changes of the flue gas and erosive action of the steam, owing to the rupture of the protective oxide layer. A metallographic examination of the structure of the tubes from the German superheater indicated that at the damaged places the section had been weakened by corrosive action. At places where the tube had burst, the entire circumference was strongly attacked. At other places where cracks had formed, failure appeared to be due to both internal and external corrosion. There was also evidence of decarburization in sections cut from undamaged parts and an increase in grain size at the edge zones where the tubes had been subjected to cold bending during the manufacture of the superheater coils. It is almost impossible to estimate to what extent these changes in the structure of the steel were due to conditions existing prior to the failure of the tube. As a result of the investigation, it is concluded that the heating surface of the superheater was too large, and, in consequence, excessive steam and tube temperatures were attained. Deposits of salts in the tubes, by checking the flow of steam, probably magnified these temperatures. A strong reaction between the steam and steel tube was created. Although the outside of the tubes was overheated, there was much more corrosion on the inner walls. It is probable that the internal corrosion was accelerated by impurities carried over with the steam, and by free O in the feed water. It is possible also that the steam velocity was too low and, thus, all the tubes were not uniformly affected; some were insufficiently cooled by the flow of steam. The highest permissible temperature at the superheater exit for the normal operation of superheaters constructed of mild steel is given as 450° C.
VVK (4)

Japanning and Rust-Proofing Electrical Part. *Metal Cleaning & Finishing*, Vol. 2, July 1930, pages 613-616.

Outlines japanning, cadmium plating, electro-galvanizing, and sherardizing procedures followed by the Steel City Electric Co., Pittsburgh, Pa.
MS (4)

Procedure in Making Surveys of Soils. Donald E. Dickey & H. Hayes (General Petroleum Corp. of California). *Oil & Gas Journal*, Vol. 29, June 5, 1931, page T-75.

The following procedure for soil survey work for pipe lines is suggested as a result of experience. (1) Careful selection of soil samples along pipe line right-of-way. (2) Record of topography, local conditions affecting soil, etc. (3) Comparison of right-of-way map with Government soil maps. (4) Measurement of soil resistivity. (5) Chemical analysis of more important soils. (6) Final selection of coatings for those portions of line where protection is necessary.
VVK (4)

Progress in Surface Protection—Protection against Corrosion (Fortschritte im Oberflächenschutz Korrosionschutz). Georg Buchner. *Oberflächentechnik*, Vol. 8, Oct. 6, 1931, pages 205-207.

Protection of surfaces against corrosion can be obtained in 2 ways: (1) The surfaces are protected by the nature and properties of the material, itself, such as resistant metals and alloys; metallic and non-metallic materials can be distinguished. (2) The surfaces are protected by suitable change of the surface which is open to attack, for instance by protective coatings of various kinds and impregnation; here, also, metallic and non-metallic materials can be used. Whenever possible, a material of the first group should be used; only when this is impossible should the second group be resorted to. An enumeration of alloy acid-resisting steels, cast iron, materials possessing temperature resistance, especially Cr-Ni steels and their particular fields of application, are given. Of non-metallic materials, glass, porcelain, earthenware, rubber, especially ebonite with resistance to fluoric acid, must be particularly mentioned. In the chemical industry, a material, "prodorite," has found wide application. It is a cement-concrete with several additions, particularly pitches and special bitumins. Coatings are produced by dipping in molten metals, calorizing, alitizing and electroplating. Coloring can also give protection in certain cases. Case hardening, nitriding or phosphate coating is another type of protection. Non-metallic protection can be obtained by wood, cement, pitch, bakelite, paraffin, waterglass, paints.
Ha (4)

Ghost of Sulfur in Gasoline Costs Americans 50 Millions a Year. Gustav Egloff, C.D.Lowry, Jr. & Paul Truesdell (Universal Oil Products Co.). *National Petroleum News*, Vol. 22, June 11, 1930, pages 41-43, June 18, 1930, pages 69-72, June 25, 1930, pages 79-80.

A survey of opinions and data in America and Europe on the question of automobile engine corrosion by S in gasoline. Tables of the S content of crude oils, gasoline and cracked gasoline are given. The author summarizes as follows. (1) No work has ever been published conclusively showing damage to automobile engines in actual use on the road from motor fuel containing more than 0.10% S (the present limit). (2) The supposition that such motor fuels do cause corrosion is based entirely on a few laboratory tests carried out at below freezing temperatures. The investigators who did the work and reported corrosion of wrist pins in their tests expressed the opinion that corrosion from S would not be a menace if all cars were equipped with crankcase ventilators which would prevent the condensation of moisture in the crankcase. These investigators, and all others who put themselves on record, have had little or no fear of corrosion when operating motors at temperatures above freezing. (3) over 70% of the gasoline used in this country is burned when the atmospheric temperatures are well above 32° F. and can, therefore, cause no corrosion. (4) A large and increasing number of the new cars coming out are equipped with crankcase ventilators. (5) Millions of gallons of gasoline are now being marketed in various parts of the United States, which contain 0.30% S, more or less, without any complaint of corrosion of engine parts. (6) Road tests of considerable extent, carried out by competent investigators with high S fuels under severe operating conditions have shown not a trace of corrosion. (7) No European country has any general S limit in its specifications for motor fuel either for automobiles or for aviation. So far as can be learned by questioning outstanding oil technologists in European countries, corrosion of automotive engines from S in the fuel is practically unknown.
VVK (4)

Corrosion Phenomena in Ship-building (Korrosionserscheinungen im Schiffbau). M. P. Andreae. *Korrosion und Metallschutz*, Vol. 7, June 1931, pages 125-133; Discussion, pages 133-134; *Metallurgist*, Sept. 1931, pages 140-142.

The paper presented at the General Meeting of the Reichsausschuss für Metallschutz, Kiel, details the experiences gained on the various kinds of corrosion attack on ocean-liners and outlines the methods of corrosion prevention. The following localities subject to corrosion are considered: (1) Parts of the stern. Cause, whirl of water + air. Opinions divided. Prevention by zinc plates. (2) Central parts of the hull, mostly rivets. Cause, uncertain. Prevention by effective paint-coating. (3) Tanks on tankers. Cause, benzine. No effective protection as yet. (4) Screw. Source, corrosion + erosion checked by utilization of special naval bronzes, brasses, proper design, dense castings. (5) Propeller shaft. Protective cover of bronze and rubber. The second part of the paper deals with the corrosion encountered in various parts of the machinery. Passing mention is given, however, only to the generally known condenser tube corrosion. A great variety of materials is still applied for ship piping and the experiences of the various ship yards are very contradictory. Recent tests on turbine pumps are described, the difficulties involved in the cooling of Diesel-engines are stressed, the corrosion of pistons and piston-rods is considered and the new problems to be solved on motor-ships are set forth. The third part of the paper pertains to heat-resisting materials employed for fire-places, waste-gas pipes, pre-heated tubes. After summarizing the experiences gained on various materials used for fittings, which are principally exposed to the attack by spray and atmospheric influences, the speaker reviews the different corrosion protection means brought on the market and outlines the significance for maritime purposes. Among the great number of corrosion resistant metals and alloys applied in ship building, the behavior of stainless steel recently used tentatively is emphasized.
VVK +EF (4)

Resistance of Copper-Nickel Steels to Sea Action. J. Newton Friend and W. West. *Iron & Coal Trades Review*, Vol. 123, July 3, 1931, page 1.

Samples containing up to about 4% Cu were cast and annealed at 920° C. and exposed to sea action for 2 yrs.; after that, a micrographic examination was made. The most resistant of the samples contained 1.16% Cu and 3.75% Ni; it lost least in weight and its general surface was free from pitting and had a fine structure. See also *Metals & Alloys*, Vol. 2, Nov. 1931, page 248.
Ha (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Physical Metallurgy Laboratory Manual. NORMAN E. WOLDMAN. Wiley & Sons, Inc., New York, 1930. Cloth, 6x9, 259 pages. Price $3.50.

The author gives as the purpose of this book "to meet a growing demand for a well illustrated laboratory manual and reference book in the metallography and heat-treatment of ferrous and non-ferrous metals and alloys." It could hardly be expected that any book of only 259 pages, a large number of which are illustrations, could adequately fill the requirements of both a laboratory manual and a reference book. It is difficult to fulfill both purposes without resorting to a more lengthy thesis. We presume that the second volume "Theoretical Physical Metallurgy" which is to be issued will contain all that the first volume lacks from a reference standpoint. The inclusion of such material as a thorough discussion of the fundamentals of the microscope, of high power metallography and X-ray examination should be left to the reference book where the discussion can be made sufficiently comprehensive to be of some value. The illustrations are excellent. Possibly they could be made of greater usefulness to the student if the descriptions were immediately under the photomicrographs. The field covered is quite broad. Among the subjects illustrated are the commercial irons and steels; cast iron; heat-treatment of steels; alloy steels; case-hardening, carburizing and nitriding; brasses and bronzes and the effect of mechanical working and heat-treatment upon them; aluminum and its alloys; bearing metals; welding, brazing and soldering; and defects and failures in metals. The chapter on defects and failures in metals is not sufficiently informative for the student. In some cases the history of the failure could be given in more detail and in others photomicrographs of the normal structure of the steel should be given alongside that of the defective material. However, there is much information of real value in the book and it should prove of considerable usefulness. V. V. Kendall (5a)-B-

Is a Change in Solid Solubility a Liability or an Asset? E. M. WISE. *Mining & Metallurgy,* Vol. 12, June 1931, pages 270-272.

The third of a series of articles contributed by the Institute of Metals Division. The Fe-C system affords a most important example of the value of a change in solid solubility. By cooling an Fe-C alloy containing C in solution at sufficiently high rate, an alloy enormously supersaturated with respect to C can be secured. Variation with temperature of the solubility of W + C, of Mo, of Be, or Cu in Fe offers a variety of precipitation hardening alloys of decreasing order of utility. In addition to C, Cr, N, P and, perhaps, O are causes of temper brittleness. Al lacks allotropic transformation characteristics of Fe and, therefore, the character of solvent undergoes no fundamental change with temperature. Intermetallic compounds such as $CuAl_2$, Ag_2Al, Mg_2Si show a marked change with temperature in the solubility in Al; due to increased dissociation at elevated temperatures, Ni base alloys may be hardened by virtue of change in solubility of certain alloying elements therein. Cu behaves similarly to Ni and Al, being devoid of any useful allotropic transformation. Au base alloys of wide range of composition are likewise amenable to precipitation hardening. Considers also alloys of Zn, Sn base alloys and extruded Pb alloys. VSP (5a)

The Ternary System Iron-Chromium-Nickel (Das Dreistoffsystem Eisen-Chrom-Nickel). F. WEVER & W. JELLINGHAUS. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, No. 6, 1931, Report No. 176, pages 93-108; *Stahl und Eisen,* Vol. 51, May 21, 1931, pages 651-652.

The results of thermal and dilatometric analysis, structural and X-ray investigations were used to establish the ternary diagram. The effect of Cr and Ni upon the polymorphism of Fe is an additive one, i. e., a continuous transition from the system Fe-Cr with its closed γ-field to the system Fe-Ni with its widened γ-field takes place. GN (5a)

Geometrical Relations Among the Structures of Modifications of a Substance (Geometrische Beziehungen unter den Strukturen der Modifikationen einer Substanz). HIKOROKI SHOJI. *Scientific Papers Institute Physical and Chemical Research* No. 328-329, Vol. 16, Oct. 1931, Abstracts, pages 81-83.

Results of investigations of the transformation of crystal lattices. According to the velocity of the transformation, the atomic or molecular groups can be arranged in planes or in helices. A number of elements and compounds with very similar structural relations are enumerated. Ha (5a)

Relationships Among the Iron Alloys (Zur Systematik der Eisenlegierungen). F. WEVER. *Proceedings World Engineering Congress,* Tokyo, 1929, published 1931, Vol. 34, *Mining & Metallurgy,* Part 2, pages 239-250.

From a correlation of the atomic radii, atomic volumes, and crystal structure of the elements, a periodic table is given showing the effect of the element on the gamma field. HWG (5a)

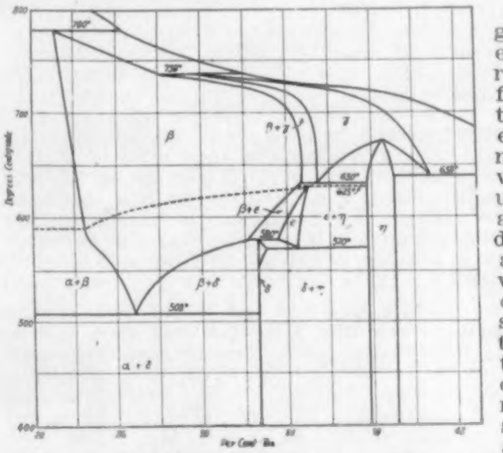
The Binary System Iron-Chromium (Zur Kenntnis des Zweistoffsystems Eisen-Chrom). F. WEVER & W. JELLINGHAUS. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, No. 10, 1931, Report 180, pages 143-147; *Stahl und Eisen,* Vol. 51, July 16, 1931, page 918.

In investigating the microstructure of pure Fe-Cr alloys, only solid solutions were observed just below the freezing temperatures. However, after a heat treatment at 600° C., the alloys with 40-50% Cr showed a new phase which disappears after heating to 1200° C. and quenching. X-ray pictures of this phase show a remarkable accordance with the compound found in the diagram Fe-V (See F. Wever & W. Jellinghaus, Mitteilungen Kaiser Wilhelm Institut, Vol. 12, 1930, pages 317-322). The new phase is supposed to be a compound with 48.22% Cr and possesses a limited solubility in its compounds. The binary diagram is newly established. GN (5a)

Some New Aspects of the Iron-Carbon Diagram. H. A. SCHWARTZ (National Malleable and Steel Castings Co.). *American Society for Steel Treating,* Preprint No. 5, 1931, 27 pages, 27 references.

Paper read and discussed at the Boston Convention of the Society in Sept. 1931. The author discusses the equilibrium diagram as an expression of certain energy relation and not merely a plot of transformation points. The Acm and Agr lines are studied in the light of the solubility equations and the specific heats of Fe, C and cementite. The author presents as conclusions justified by the discussion, (1) graphitization is a phenomenon occurring in as nearly pure binary alloys as are obtainable; (2) if graphitization can occur at a given temperature, it can also occur at any higher temperature where the solid alloy exists; (3) graphitization can occur at 650° C. (1200° F.) but there may be a limiting temperature below which cementite is stable, no data are available for calculating this temperature as it exists; (4) austenite and boydenite are distinct in kind and not identical when of the same C concentration; (5) the thermal data show no evidence of the decomposition of cementite on passing into solution in austenite; (6) reasons exist for not attempting to show without further evidence that solid Fe is monatomic. WLC (5a)

On the Equilibrium Diagram of Copper-Tin Alloys. MATSUJIRO HAMASUMI & SEIJI NISHIGORI, Technology Reports Tohoku Imperial University, Japan, Vol. X, June 1931, pages 131-187.



The equilibrium diagram of Cu-Sn system, especially that of the range of composition from 15-41% Sn, was thoroughly investigated by means of several methods. The liquidus was determined by the usual thermal analysis and the solidus, by the differential thermal analysis. For the investigation of the change in the solid state, the differential thermal analysis, dilatometric measurement, electrical resistance measurement, microscopic examination and the X-ray analysis were applied. The figure shows the diagram obtained by the present investigation. In this region, 4 solid phases, β, γ, δ and η exist, as determined by previous investigators. Besides, a new phase, ϵ was found by the present investigation. The η-phase, consisting of a compound Cu_3Sn, is formed from the γ-phase after solidification; the freezing interval of an alloy with this composition is about 20°. The δ-phase corresponds to a compound $Cu_{13}Sn_8$, as already pointed out by Westgren, but not Cu_4Sn as formerly considered by previous investigators. There occur 8 non-variant reactions, which are shown in the following scheme:—

α+melt β (780°); β+melt γ (738°);
γ η+melt (638°); γ $\beta+\eta$ (630°);
$\beta+\eta$ ϵ (626°); $\beta+\epsilon$ δ (580°);
ϵ $\delta+\eta$ (570°); β $\alpha+\delta$ (508°).

The change observable at 580° in the $\alpha+\beta$ field is due to the rapid change of solubility of the α-phase in the β-phase but not to the allotropic change in the α-phase. The β-phase shows the different structure by quenching, according to the composition; that is, alloys with up to 25% of Sn show an acicular structure; those of 25-28% of Sn are homogeneous; those in which the δ-phase primarily separates on slow cooling show the troostitic structure by quenching; while those in which the ϵ-phase primarily separates on slow cooling is homogeneous by quenching. The field in which β- and γ-phases coexist, is markedly upward convex. The eutectoid structure $\beta+\eta$ to be formed at 630° is observable only by rapid cooling; by slow cooling the β- and ζ-phases grow to large crystal. The new phase, ϵ, exists in the temperature range between 630° and 570°, being formed by the pertectoid reaction, $\beta+\eta\rightarrow\epsilon$, at 625° and decomposes into $\delta+\zeta$ by the eutectoid reaction at 570°, which is readily supercooled to the room temperature. The δ-phase is formed by the peritectoid reaction, $\beta+\epsilon\rightarrow\delta$, at 580° and has no range of solid solution at the room temperature. The η-phase has nearly 1% of the range of solid solution between 37.8-38.9 % of Sn. There is a remelting reaction at 638° on cooling, by which the γ-phase changes to the η-phase and the melt, as pointed out by the previous investigators. See also *Metals & Alloys,* Vol. 2, Nov. 1931, page 249. TM (5a)

The Diffusion of Tin into Iron with Special Reference to the Formation of Columnar Crystals. BANNISTER & W. D. JONES. *Engineer,* Vol. 152, Oct. 2, 1931, page 346.

Abstract of a paper read before the Iron & Steel Institute, Swansea, Sept. 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 302. LFM (5a)

Regeneration of the Recrystallization Ability by Retro-Formation (Rückbildung des Recristallisationvermögens durch Rückformung). P. BECK & M. POLANYI. *Zeitschrift für Elektrochemie,* Vol. 37, Aug.-Sept. 1931, pages 521-524.

The object of this investigation was to discover to what extent the recrystallization which starts by bending a crystal rod can be eliminated by bending it back again and whether, if this takes place, the densification goes back, too, or progresses further (as has heretofore been assumed) even at retrograde recrystallization. The tests were made on Al crystals. The conclusion reached was that it depends on the degree of deformation if a recrystallization occurs under the conditions specified before, but the ability for recrystallization is reduced by retro-forming; the densification is not. Ha (5a)

The Magnetic Properties of Cobalt-Chromium Solid Solutions in Dependence on the Temperature (Die Temperaturabhängigkeit der magnetischen Eigenschaften bei den Kobalt-Chrom-Mischkristallen). F. Wever & H. Lange. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 12, No. 22, 1930, Report No. 167, pages 353-363; *Stahl und Eisen,* Vol. 51, Feb. 26, 1931, pages 264-265.

The investigation continues the investigation made by F. Wever and U. Haschimoto, *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 11, 1929, pages 293-330. After describing the apparatus and the method for taking the magnetizing-temperature diagrams of the above-mentioned solid solutions in the concentration range up to 15% Cr, the results are presented and discussed and the former equilibrium diagram is completed. Most remarkable is the large hysteresis of the phase transformation and the parallel course of the magnetic transformations of the α-phase and β-phase. The large hysteresis of the phase transformation is theoretically explained. In accordance with the nature of the β-transformation of pure Fe, the magnetic transformation of the system Co-Cr does not have the properties of a phase transformation. GN (5a)

The Effect of Alloying Elements upon the Polymorphic Transformations of Iron (Ueber den Einfluss von Legierungselementen auf die polymorphen Umwandlungen des Eisens). F. Wever. *Mitteilungen Kaiser Wilhelm Institut für Eisenforchung,* Vol. 13, No. 14, 1931. Report 184, pages 183-186.

The alloying elements of Fe are classified in 2 groups, according to the effect on the polymorphic transformations. In the first group belong those elements which increase the stability of γ-iron and correspondingly shift the transformation towards the α-iron side. The other group comprises those elements which show just the opposite effect from the first mentioned group. Each of these 2 groups may be still further sub-divided, whether or not the solubility is sufficient to form γ-solid solutions without a gap of miscibility or a closed γ-field or whether or not 3 phase equilibria exist among α-solid and γ-solid solutions and a ternary crystal type. It is shown that the behavior of the alloying elements mentioned above cannot be explained by crystallographic relations but a simple relation can be established to the radii of the atoms. GN (5a)

On the Possibility of Grain Growth of Steel below the Pearlitic Transformation (Über die Möglichkeit des Kornwachstums im Stahl unterhalb der Perlitumwandlung). F. Sauerwald & F. Pelka. *Stahl und Eisen,* Vol. 51, Oct. 29, 1931, page 1344.

Cylindrical specimens (diameter, 25 mm.; height 25 mm.) of a steel containing 0.48% C, 0.29% Si, 1.01% Mn, 0.044% P, 0.27% S, 0.13% Cu which is used as a die steel where subjected to a load of 4 kg./mm.^{2} at 600° C. for 12 hrs. in order to determine whether or not slight deformations cause a grain growth. No such effect could be observed. Further experiments with repeated heating and cooling made no change in the structure. Evidently the possibility of crystallization, even after a slight preceding deformation, is very limited below the pearlitic temperature in higher C steels. GN (5a)

Austenite and its Decomposition (L'austénite et sa décomposition). A. Sauveur. *Congrès International des Mines, de la Métallurgie et la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 335-342.

Discussion of dendritic and Widmanstätten structures. Compare article of same title in Transactions American Society for Steel Treating, Vol. 17, February, 1930, pages 199-218.

See *Metals & Alloys,* Vol. 1, Oct. 1930, page 794. HWG (5a)

The Time Law of the De-Strengthening of Deformed Metals (Ueber das Zeitgesetz der Entfestigung verformter Metalle). F. Sauerwald. *Zeitschrift für Elektrochemie,* Vol. 37, Aug.-Sept. 1931, pages 531-534.

The de-strengthening of deformed metals can take place in 2 different ways: (1) crystals in which a strengthening has taken place by plastic deformation can "recover" again thereby reducing the resistance to deformation; (2) new crystals can form which do not show any strengthening (this is the case particularly in a conglomeration of deformed crystallites). The total deformation resistance of a metallic body is also reduced here. The times necessary for recovery and de-strengthening by recrystallization were measured on cylindrical samples of 10 or 15 mm. diameter by measuring the hardness after a definite cold treatment. The curves are reproduced. Ha (5a)

Comment on the Cu-Pb and Similar Heterogeneous Systems (Zur Kenntnis des Systems-Kupfer-Blei, und verwandter heterogener Systeme). W. Claus. *Kolloid-Zeitschrift,* Vol. 57, No. 1, 1931, pages 14-16; *Zeitschrift für Metallkunde,* Vol. 23, Sept. 1931, pages 264-265.

The curve separating the 2 liquid-layer field of the Cu-Pb system from the field for homogeneous melt shows its zenith at 1600° C. when electrical conductivity of the melt is taken as a criterion but, on the basis of holding at temperature for hours and analyzing the top and bottom of the melt, the existence of 2 liquid layers appears to begin only after cooling to about 1000° C. Claus' explanation for this seeming discrepancy is that the 2 phases are present as an emulsion, so that the equilibrium diagram should be drawn with the peak of the curve at 1600° C., to show a 2-phase field, but that this dispersion separates at lower temperatures into 2 actual layers, so the 1000° C. peak represents the agglomeration of the dispersed particles into masses large enough to separate, rather than a true phasial boundary. RFM + HWG (5a)

The "Graphitization Curves" of N. Hekker (Ueber die "Graphitisierungskurven" nach N. Hekker.) A. Merz & H. Schuster. *Giesserei mit Giesserei-Zeitung,* Vol. 18, June 19, 1931, pages 496-499.

The author disagrees with Hekker in believing that equilibrium curves in the Fe-C diagram can be calculated and shows with different examples that the actual conditions do not agree with Hekker's calculations. Ha (5a)

Structure & X-ray Analysis (5b)

The Scattering of X-Rays from Paraffin, Aluminum, Copper and Lead. Allen W. Coven. *Physical Review,* Vol. 38, Oct. 1931, pages 1424-1431.

The radiation from a W-target X-ray tube operated at 80 kv. was filtered through 0.244 cm. Al and the intensities of the scattered radiations from, paraffin, Al, Cu and Pb were observed by the ionization method. The scattered intensities at angles in the range of 30° to 120° with the forward direction of the primary beam were compared with the scattered intensities at 90°. The scattering from paraffin and Al was at an effective wave length of 0.32 A.U.; from Cu 0.26 A.U. and from Pb 0.27 A.U. WAT (5b)

Hexagonal Nickel (Über hexagonales Nickel). G. Bredig & E. Schwarz von Bergkampf (Technische Hochschule Karlsruhe). *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 172-176.

New tests confirmed that a metallic, unmagnetic Ni-deposit of hexagonal atomic arrangement is secured by the cathodic atomization of Ni in an atmosphere of hydrogen. Slight rise in temperature in an H_2-current causes the unmagnetic hexagonal Ni to be converted into the regular magnetic Ni of the cubic lattice. The same phenomenon was observed if N was employed instead of H. The structural arrangement was investigated by X-rays. EF (5b)

X-Ray Investigations in the System Cd-Mg (Roentgenographische Untersuchungen am System Cd-Mg). U. Dehlinger. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 194, Dec. 9, 1930, pages 223-238.

The experiments were made by the method of Debye-Scherrer on alloys containing 30%, 33.3%, 40%, 42%, 55%, 65% and 80% (atomic) Mg after annealing at 300° C. for 4 weeks and subsequent quenching. 2 series of solid solutions exist at this temperature; they are separated from each other by a gap between 30 and 40% Mg. They possess the lattice of hexagonal, densest sphere arrangement of Cd and Mg, respectively, with a ratio of the axes of 1.89 and 1.62 respectively in all tested compositions. 25-65 atomic % of the 2 series of solid solutions are mutually transformed under the influence of the pressure (cold working). $MgCd_3$ and $CdMg_3$ which contain all lines of the spectrum of Cd and Mg in unchanged location and intensity are formed. Additional lines which are due to an ordered atomic distribution are, however, also present. The lattice dimensions have been determined. Ha (5b)

The Rearrangement of a Solid Metallic Phase (Über Umwandlungen von festen Metallphasen). U. Dehlinger & L. Graf. *Zeitschrift für Physik,* Vol. 64, Aug. 28, 1930, pages 359-377.

From X-ray diagrams of a Cu-Au alloy (50 atomic % Cu and 50 atomic % Au), the conclusion is drawn that the transition of the modification consisting of cubic solid solution to the tetragonal system passes through a well characterized intermediate phase of definite lattice constant and tetragonal symmetry, though the atoms are only partly ordered. The electric conductivity is found to go parallel to the structural change. Though the cubic and the tetragonal modification are very soft, the intermediate state is exceedingly hard. The cause for the transition of the cubic phase to the tetragonal intermediate state must be due to the valency electrons. (5b)

Investigation of Gold-Copper Alloys by the Refraction of Rapid Electrons (Untersuchung von Gold-Kupfer-Legierungen mittels Beugung schneller Elektronen). O. Eisenhut & E. Kaupp. *Zeitschrift für Elektrochemie,* Vol. 37, Aug.-Sept. 1931, pages 466-473.

An apparatus for the examination of matter by means of electron refraction and the method used are described. These investigations are possible for practical purposes. The electrons used had a velocity of 20-70 kv., which corresponds to wave lengths of 0.085-0.044 A.U., which is shorter than the X-rays usually applied. The difference between the 2 methods is that the interferences of the refraction of the electron give a picture of the state of the very exterior layers of the metal because they do not penetrate more than a few hundred layers of the atoms, while X-rays penetrate deeper. The application of these electrons on Au-Cu foils shows that the time of the formation of the uniform solid solution depends on the annealing temperature. A tetragonal structure could be proved for a 50% Au-Cu alloy. For a thermal treatment above 400° C. of 50% Au-Cu and also Au-Al, a lattice of the type of zinc blende exists. 10 references. Ha (5b)

Secondary Emission From Nickel by Impact of Metastable Atoms and Positive Ions of Helium. Marshall C. Harrington. *Physical Review,* Vol. 38, Oct. 1931, pages 1312-1320.

Experiments on the secondary electron emission from nickel electrodes due to bombardment by positive ions and metastable atoms in a helium discharge under conditions similar to those obtaining in a glow discharge are reported. The method of measurement is similar to that of Uyterhoeven and Harrington. The proportion of the measured current at the cathode which is carried by electrons is found to be 15 to 50% depending upon experimental conditions. Similarly, the number of electrons per slow positive ion is found to range between about 8 and 20%. The secondary electrons originate at the surface of the collector with about 15 volts maximum initial energy. WAT (5b)

The Structure of Rolled Cadmium (Ueber die Walztextur von Cadmium). E. Schmid & G. Wassermann. *Metallwirtschaft,* Vol. 10, Sept. 18, 1931, pages 735-736.

Contains 3 references. Cadmium sheet 10 mm. thick was cold rolled to 0.05 mm., cooling in water between passes. In spite of cooling, some recrystallization takes place. X-ray patterns were taken at various angles according to the method used previously by the authors for other metals and the results are summarized diagrammatically. The crystal orientation in rolled Cd is very similar to that in rolled Zn. CEM (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

On a Magnetic Testing Method for Wire Ropes (Über ein magnetisches Verfahren zur Prüfung von Drahtseilen, insbesondere Förderseilen). F. WEVER & A. OTTO. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 12, No. 24, 1930, Report No. 170, pages 389-390; *Stahl und Eisen,* Vol. 51, Apr. 9, 1931, pages 468-469.

The new magnetic testing method for tubes which was previously described was used to test a wire rope of unknown origin. Disturbances on the magnetization curve of the rope were shown to be due in all cases to cracks of the individual wires. Increased disturbances indicated cracks of 2 wires at the same location of the strand. GN (6)

Riveted and Welded Bridge Tests. *Canadian Engineer,* Vol. 58, June 10, 1930, page 665.

An extended abstract of a paper by R. BERNHARD in the *Zeitschrift Verein deutscher Ingenieure,* Nov. 23, 1929, See "Continuous Tests on Riveted & Welded Bridges," *Metals & Alloys,* Vol. 1, Nov. 1930, page 845. VVK (6)

Wire Rope Testing Machine. *Metallurgia,* Vol. 4, Sept. 1931, pages 139-140.

A description of the million pound capacity vertical machine recently made for the Canadian Department of Mines. The machine can test wire rope specimens of 11 in. circumference and 6 ft. long. JLG (6)

On the Relaxation Times of Some Materials under Dynamic Stress (Ueber die Relaxationszeiten einiger Werkstoffe bei dynamischer Beanspruchung). A. ESAU (University of Jena). *Zeitschrift für technische Physik,* Vol. 12, Sept. 1931, pages 492-495.

A formula of Becker (*Zeitschrift für Physik,* Vol. 33, 1925, page 125) originally developed for the determination of the damping ability of materials was employed to determine experimentally the relaxation time 1/R (R = the material constant) of the following alloys: brass = 1/1 500, Duralumin = 1/750 and Electron-metal: 1/50 —1/100. EF (6)

The Effect of Rate of Bending in Notched-Bar Bending Tests. JAMES GRAY DOCHERTY. *Engineering,* Vol. 131, Mar. 13, 1931, pages 347-350; Mar. 27, 1931, pages 414-415.

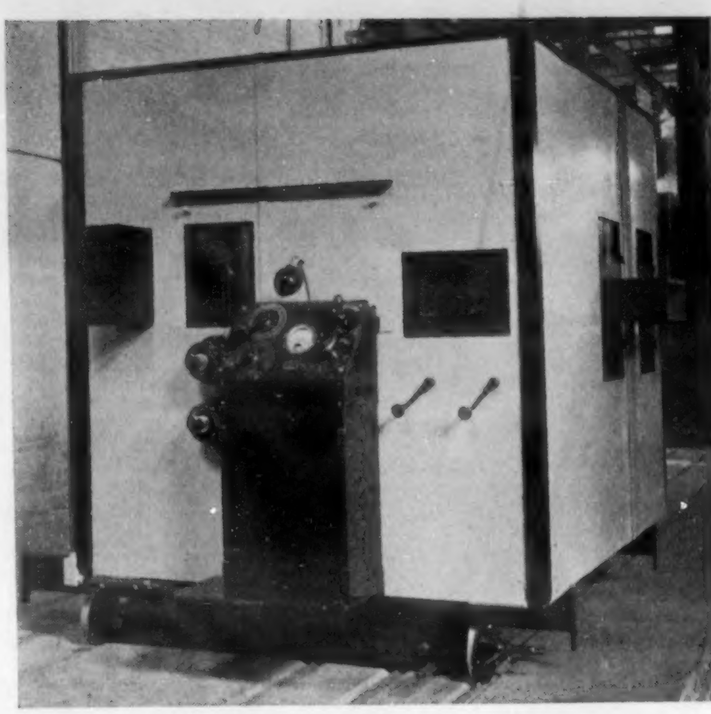
Attempt was made to show the relation between the slow bend and the Izod notched-bar test. Tests were carried out on the following metals: 0.25% C steel as rolled and normalized, normalized 0.35% C steel, normalized 3% Ni steel, Monel metal as rolled and annealed, annealed naval brass, phosphor bronze as rolled and annealed and heat treated Cr-Mo steel. In these tests the maximum rate of travel has been increased from 50 in./min. to 150 in./min. The slowest rate used was 0.05 in./min. Results of the notched-bar bending tests are shown plotted on a logarithmic scale; separate figures are used to show energy, energy absorbed, maximum load, and values of ductility factor. Results of these tests show that for all the ductile metals tested including annealed naval brass; the energy absorbed in bending or in fracture increases with the speed of test. In the case of annealed Monel metal the type of fracture becomes more brittle with slower rates of testing. In actual fracture there is much less plastic flow and much greater opening at the root of the notch. This may indicate that fracture proceeds first by ductile shearing but later in the test, stress concentrations are such that brittle cracking occurs. Annealed Monel metal is not abnormally lacking in toughness at low speeds but is abnormally tough at high speeds. The decrease of load begins much earlier in the test of nickel steel and the rate of decrease is much more rapid in the case of mild steel. The crack once started travels for a considerable distance. This is shown by the audibility of the crack during the test, the appearance of a bright band across the broken face of the specimen, and by the sudden drop of load in the diagram. In the case of nickel steel at the lowest speeds of test, the proportion of specimens which crack is small. The crack is slight showing a narrow bright band and the energy lost due to the slight drop of load is small. The energy absorbed by the uncracked specimens increases with speed and the falling off of the mean of all tests at higher speeds is due to increasing violence of the crack and to the greater number of cracked specimens. Energy absorbed during notched-bar bend tests depends mainly on the maximum load carried during the test and the travel of the striker before the load begins to fall off rapidly. The energy absorbed in each test was divided by this maximum load giving an "equivalent length of diagram." This is large for ductile materials and small for brittle materials. This length may then be called the "ductility factor." In all materials examined, the maximum load increases with speed. The ductility factor increases with the speed only in the case of annealed phosphor bronze and naval brass. Tests were also made to determine the relation between the notched-bar test and the ordinary tensile test. Curves are given showing the results of these tests. LFM (6)

Photoelasticity Assumes Prominent Place in Stress Determination. *Machine Design,* Vol. 3, Nov. 1931, pages 38-39.

The photoelastic method was used to determine the stresses of sheet mill housings and press frames; this resulted in changing the design to a better one of less severe stress concentrations. Several qualities of steel were used in these tests. Ha (6)

The Structure Sensitiveness of Magnetism in Metals. F. E. LOWANCE & F. W. CONSTANT. *Physical Review,* Vol. 38, Oct. 1931, pages 1547-1551.

The magnetic susceptibility of Cu, Ag, Pt and Bi was measured for the annealed state and after various degrees of cold work. The cold work consisted of twisting, stretching and pounding. In every case the cold work decreased the diamagnetism (Cu, Ag, Bi), or increased the paramagnetism (Pt). This probably explains the variation in the measured values of metallic susceptibilities as due to a structure sensitiveness. This is attributed to the increase in the paramagnetic contribution of the partly bound electrons of the metal due to cold work. The electrical conductivity is usually decreased. WAT (6)



G-E x-ray installation at Saginaw Works of Wicks Boiler Co. With this equipment, 34 inches of longitudinal seam are radiographed at each exposure.

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with A.S.T.M. Research Committee on Fatigue of Metals.

The Fatigue of Aircraft Parts. J. B. Johnson. *Aviation*, Vol. 30, Sept. 1931, pages 542-546.

"Under-stressing" is the application of repeated stresses at, or just below, the fatigue limit. It has an effect similar to cold working increasing the tensile strength and fatigue limit and reducing the ductility. The increase is small for heat-treated steels, but in the case of 18% Cr, 8% Ni specimens, previously cold drawn, which had been run for 100,000,000 cycles at the fatigue limit (62,000 lbs./in.^{2}) these were run at 70,000 lbs./in.^{2} for 5,000,000 cycles. A further increase to 72,000 lbs./in.^{2} resulted in failures between 75,000 and 100,000 cycles. The fatigue limit of cast iron has been increased 30% and of Cr-Mo cast steel has been increased 20%. "Over-stressing" is the application of original stresses higher than the fatigue limit. A few experiments indicate that a specimen may be over-stressed for a limited number of repetitions without decreasing the fatigue limit. DTR (6f)

Staybolts. Correspondence from H. L. Miller, Central Alloy Division, Republic Steel Corp. *Metals & Alloys*, Vol. 2, Sept. 1931, pages 109-110.

The writer describes comparative corrosion fatigue tests between wrought iron, and Cu-Mo and Ni alloy staybolt irons. Properties and heat treatments are reported. Superiority of alloy steels over wrought iron is shown. WLC (6f)

Universal Testing Machine for Alternating Fatigue Loads (Universalprüfmaschine für Dauerwechselbelastung). K. Rathke. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Oct. 10, 1931, page 1289.

A machine of the Losenhausenwerk, Düsseldorf, for tensile, compression and bending tests is described. The material can also be subjected to a pre-stress of any amount, beside the alternating load. The reading instruments can be arranged apart and remote from the machine. Ha (6f)

Fatigue Strength of Carbon and Alloy Steel Plates as Used for Laminated Springs. R. G. C. Batson & J. Bradley. *Proceedings Institution Mechanical Engineers*, Vol. 120, Feb. 1931, pages 301-332.

Includes discussion. Tests were made to ascertain the effect of grinding away the outer skin of the plate on the limiting range of stress under repeated loadings and to discover if the surface effect of the heat-treated spring plates was due to the heat treatment. The analyses of the steels used are given and the testing methods are described in detail. From the results, it can be stated that the condition of the surface layer was the principal factor in causing the fatigue resistance of complete laminated springs to be considerably below that which would be expected from the known mechanical properties of the material of which they were composed. The thickness of the deleterious layer was found to be small. By machining 1/16 in. from the surface, it was practically completely removed; usually, even 10/1000-15/1000 in. would be sufficient. This surface effect was found to be produced by hardening and tempering. Only slight (if any) improvement was obtained by heat treating the spring plates *after* the thin layer had been machined from the surface of the rolled material. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. Ha (6f)

Fatigue Tests of Weld Metal. R. E. Peterson & C. H. Jennings. *Proceedings American Society for Testing Materials*, Vol. 31, pt. 2, 1931, pages 194-203.

See abstract of preprint. *Metals & Alloys*, Vol. 2, Nov. 1931, page 257. Includes discussion, in which it was brought out that better fatigue results would be expected were coated (fluxed) welding electrodes used instead of bare ones. HWG (6f)

Fatigue Stresses, with Special Reference to the Breakage of Rolls. Frederic Bacon. *Proceedings South Wales Institute of Engineers*, Vol. 47, Part 1, Sept. 15, 1931, pages 374-397.

Discussion of article abstracted in *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. AHE (6f)

The Loading Capacity of Bearings for Cylinder Rolls. (Ueber die Tragfähigkeit von Zylinderrollenlagern.) Robert Mundt. *Maschinenbau*, Vol. 10, May 21, 1931, pages 354-357.

The author indicates how to choose the bearings. The specific load is used as an expression of stress on the loaded surface. The relation between life of the bearing and residual load is calculated and an attempt is made to establish an idea of specific stress. Life of the bearing is reduced in fatigue tests. The choice of a suitable and workable conception of the length of life and the premature failure of the bearing is discussed. Calculations are made from load data obtained from 4 reliable roller-bearing manufacturers. The establishment of the hypothesis used in evaluating the data is necessary. MAB (6f)

Fatigue Tests on the M. A. N. Machine. *Metallurgist*, Mar. 1931, pages 44-45; *Mitteilungen aus den Forschungsanstalten (Gutehoffnungshütte)*, Vol. 1, Sept. 1930, page 8.

A. Junger describes experiments on the M.A.N. machine, investigating the effect on the fatigue strength of the condition of the surface of the material and also to see how welded joints behave under alternating loads. Corrosion fatigue experiments are also described. VVK (6f)

Fatigue and Fatigue Testing. *Metallurgist*, Apr. 25, 1930, page 55; May 30, 1930, pages 75-76.

In discussing the notched-bar repeated impact test (the Krupp test) this article notes that investigations made several years ago at the British National Physical Laboratory by Stanton and others showed that if the energy per blow were high the results of repeated-impact tests on notched specimens arranges metals in the same order of merit as Charpy or Izod test results, while for tests with a small amount of energy per blow, the same order as that indicated by fatigue test results. It may be noted that McAdam's results take this conclusion in a general way. The author concludes that the repeated-impact test does not appear to indicate any special inherent property of a metal different from those determined by other tests. (6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Analysis vs. Guesswork. Theodore Ross (Chromium Service & Sales Co., Inc.). *Metal Industry*, N. Y., Vol. 28, Mar. 1930, page 126.

High standard of workmanship and intensive economy in production costs is rigidly controlled by chemical analysis. Periodic chemical analysis is required to see that quality of nickel solution has not changed. Ni, Cl, alkalinity and boric acid are important parts of nickel plating solution. VSP (7a)

Chromium Plating Technique. Robert D. Zimmerman (Ingersoll-Rand Co.). *Metal Progress*, Vol. 19, June 1931, pages 54-59, 102.

The author describes solutions used and general technique of chromium plating for resistance to abrasive wear. WLC (7a)

Characteristics of Chromium Plating Baths (La détermination de quelques caractéristiques d'un bain de chromage dur). E. de Winiwarter & J. Orban. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 555-560.

Various baths containing CrO_3, $Cr_2(SO_4)_3$ and $NaHSO_4$ were studied, and the temperatures and current densities at which bright deposits were obtained are plotted. Each bath has a definite range outside of which the deposits were not satisfactory. The center of the area within which good deposits were obtained is around 50° C. and 15 amp./dm.^{2} for a bath of 350 gr. CrO_3/liter, 5 gr. $Cr_2(SO_4)_3$/liter, 4 liters distilled H_2O, and about 55° C, 80 amp/dm.^{2} for one of 350 gr. CrO_3/liter, 5 gr. $Cr_2(SO_4)_3$/liter, 5 liters distilled water, + 60 gr. $NaHSO_4$. Intermediate compositions show intermediate loci of satisfactory deposits. The former bath has greater flexibility as to temperature, the latter as to current density. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 175. HWG (7a)

The Measurement of pH Value in Aged Electrolytic Bath with Emphasis on the Ni-Bath (Die Messung der Wasserstoffzahl in galvanischen Veredlungsbädern unter besonderer Berücksichtigung der Nickelbäder). M. Willmer. *Oberflächentechnik*, Vol. 8, Jan. 6, 1931, pages 1-2.

Commercial electrometric and colorimetric methods for determining the pH value in aged electro-plating baths are described with emphasis on the Ni-bath. Factors influencing the accuracy of measurement of pH value are cited. The experiments showed that, for commercial purposes, a temperature between 20 and 30° C. is best and quinhydrone electrode shall be used. For the colorimetric determination of pH value, bromcresol green and bromcresol red were found to be most suitable; however, oxidizing salts must be absent. ER (7a)

Colorings on Aluminum (Färbungen auf Aluminium). E. Werner. *Oberflächentechnik*, Vol. 8, Aug. 18, 1931, pages 175-176.

The possibility of successfully electroplating pure Al and cast Al, which is often doubted, is defended. It is, of course, necessary to make the material absolutely free of grease and oxide films. The author recommends that a so-called "connecting bath" consisting of 100 g. stannous chloride, 100 g. stannic sodium and 100 g. zinc sulphate be applied first; at room temperature and 3 volts, this gives a good deposit on which, later, Cu or Ni can be deposited; but the temperature must not be too high. The experiments also showed that, for nickel plating, the electrolyte must contain at least as much salts of Mg as salts of Ni. The causes of the formation of blisters are discussed; this may, very likely, be ascribed to too great heating of the parent material which the hard nickel deposit cannot follow directly. Al alloys with Mg (electron and magnalium) cannot yet be satisfactorily electroplated. The tests are not yet concluded. Ha (7a)

The Stability of Cadmium Cyanide Plating Solutions. S. Wernick. *Preprint, Transactions Electrochemical Society*, Vol. 60, Sept. 1931, pages 117-128.

A study of the Cd bath was made mainly to find a set of conditions under which the anode efficiency would equal to cathode efficiency, or, the anode-to-cathode-efficiency ratio would equal to unity. Experimental results show (1) in the presence of little or no free cyanide, the anode to cathode efficiency ratio changes inversely as the Cd content of the bath; (2) with 30 g./l. Cd, the free cyanide content may vary from 50% to 150% (8.68 to 26 g./l. KCN) without increasing the anode to cathode efficiency ratio; (3) NaOH helps to reduce the ratio in a small degree, it has less effect upon conductivity of the electrolyte; (4) current density has marked effect upon anode to cathode efficiency ratio. High current density up to 4.4 amp./dm.^{2} reduces the ratio but makes deposit dark and coarse-grained; (5) temperature increases directly with the anode to cathode efficiency ratio. Deposit becomes spongy above 35° C.; (6) conductivity of electrolyte increases directly with Cd content, free cyanide content and temperature. Anodes of stainless steel are recommended to replace up to 75% of the Cd anodes in order to reduce the tendency of the electrolyte to increase its Cd content. LCP (7a)

Passive and Dense Nickel Deposits, "Armor-Nickel" (Passive und dichte Nickelniederschläge "Panzernickel"). Carl Schuch. *Oberflächentechnik*, Vol. 8, Oct. 6, 1931, pages 208-209.

Normal Ni deposits are always more or less porous and offer, therefore, no absolute protection against corrosion. A Cr deposit is often applied on top of the Ni to impart a denser coating. The new method obtains density of the Ni deposit by preventing the H from depositing with the Ni. In this manner, a film of Ni with only 1-4 pores/cm.^{2} was obtained as compared with more than 12 in the normal deposit. A microphotograph shows the extremely dense, uniform deposition. The method is developed by the Electrochemical Works of F. Blasberg. The composition of the bath is not disclosed. Ha (7a)

Plating of Aluminum for Protection. H. C. COCKS. *Chemical Age*, London, Vol. 22, May 24, 1930, pages 485-486.
A paper before the Electroplaters and Depositors' Technical Society. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 38.
VVK (7a)

Difficulties of the Electrodeposition of Chromium. J. W. CUTHBERTSON. *Chemical Age*, London, Vol. 23, Metallurgical Section, Nov. 1, 1930, pages 25-26.
Extracts from a paper before the Electroplaters' and Depositors' Technical Society. The work should be ground and polished, cleaned of grease by alkaline electrolytic cleaning, swilled in 10% sulphuric acid, rinsed in water, scrubbed with fine sand for brass and pumice for steel and again rinsed. After cleaning and before nickeling it should not be touched with the bare hands. The best results in Cr plating are obtained from a solution of chromic acid and chromic sulphate in water. Pb anodes should be used as Fe anodes are attacked by the solution, decrease the throwing power and increase the resistance of the solution. The efficiency of the bath depends on the chromic acid-chromium sulphate ratio which is also affected by the temperature and current density. The temperature should be 40° C. ± 3°, the current density 65 to 85 amps./ft.^{2}. Difficulties in technique are also discussed. See also *Metals & Alloys*, Vol. 2, Feb. 1931, page 38.
VVK (7a)

Industrial Education for Electroplating Industries. C. L. MANTELL. *Metal Industry*, New York, Vol. 28, Aug. 1930, pages 385-386.
Describes a 2 year non-collegiate course of training in the department of industrial chemical engineering of the school of science and technology at Pratt Institute. See also *Metals & Alloys*, Vol. 1, Oct. 1930, page 797.
VSP (7a)

Conference on Electroplating Standards. *Monthly Review American Electroplaters' Society*, Vol. 18, Apr. 1931, pages 17-22.
The proposed standards and specifications cover materials used in plating, electroplated products, thickness and color of coating.
Ha (7a)

Electro-Deposited Cadmium as a Rust Preventative. *Metal Industry*, London, Vol. 37, Aug. 8, 1930, pages 131-132; Aug. 22, pages 181-182.
Abstract translation of an article "Elektrolytische Kadmiumniederschläge als Rostschutzmittel" in *Zeitschrift für Metallkunde*, Feb. 1930. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 848.
VSP (7a)

Electroplaters' Annual Convention. *Metal Cleaning & Finishing*, Vol. 2, July 1930, pages 601-608, 624.
Report of the eighteenth annual convention of the American Electroplaters' Society. Includes abstracts of the papers presented.
MS (7a)

Electroplating on Cold-Rolled Steel. GEORGE B. HOGABOOM. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, pages 390-392.
Paper read before American Electroplaters' Society, July 1931, and published in the Monthly Review, August 1931. Includes discussion. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 258.
PRK (7a)

The Control of Acidity and Alkalinity in the Metal Plating Industry. *Metal Cleaning & Finishing*, Vol. 3, Apr. 1931, pages 281-284, 302.
The pH-scale is explained and theoretically discussed. The colorimetric method of measuring the hydrogen ion concentration pH with the comparator set is described and a table giving the pH range and color changes for a number of liquids are added.
Ha (7a)

The Mechanical Properties of Copper Deposits. *Brass World*, Vol. 27, July 1931, pages 153-155.
Addition agents have been found the most effective in improving the mechanical properties of Cu plating. The Brinell hardness range of Cu deposited under widely differing conditions from acid sulphate solutions free from organic matter is narrow; there is also a considerable tendency for the formation of rough and nodular deposits at high current densities. No addition agent has been found that has an appreciable influence in effecting the production of smooth deposits at high current densities and which, at the same time, does not materially increase the hardness of the deposit. Phenol can be used in concentrations up to 10 g./liter, and as a chemical method is available by which its concentration can be controlled it appears eminently suitable for use in acid copper sulphate solutions.
WHB (7a)

The Titration of Free Cyanide in Silver Plating Solutions. *Metal Cleaning & Finishing*, Vol. 3, Feb. 1931, page 104.
With a stock solution of potassium argentocyanide, the titration of the free cyanide of silver nitrate could be carried out without having to remove the carbonate present in silver plating solutions, provided dilution sufficient to take care of any interference due to the carbonate is used.
Ha (7a)

Electro-deposition in Non-Aqueous Solvents. *Metallurgist*, July 1931, pages 100-102.
Recent researches, particularly in America, has directed attention to electrodeposition in non-aqueous solutions. At present there is a mass of uncorrelated and to some extent conflicting data on a number of solvents differing widely in physical and chemical properties. The history, with examples, of metal deposition from non-aqueous solutions is briefly reviewed.
VVK (7a)

The Draft Regulations for Chrome Plating. *Chemical Age*, London, Vol. 23, Aug. 2, 1930, pages 102-103.
The regulations of the Medical Inspectors of Factories in regard to Cr plating were discussed by Dr. S. G. Overton at a meeting of the Electroplaters and Depositors' Technical Society in London. The present regulations require exhaust drafts as near the point of origin as possible, bath facilities, rubber or leather boots, gloves and aprons and medical examination every 14 days. A mixture of 3 parts vaseline and one part lanoline should also be rubbed in the nostrils and on the hands as a preventative both before and after work.
VVK (7a)

Modern Nickel Plating Technique (Die neuzeitliche Vernickelungstechnik). *Oberflächentechnik*, Vol. 8, July 7, 1931, pages 141-142.
A general discussion of modern tendency to use plating baths for quick and thick deposits of Ni. This is obtained by a high percentage of metal with a low percentage of salt (about 2-3% of the metal content). The reasons for acid and alkaline reactions are discussed and the meaning of the pH value which is determining for the acidity or alkalinity of the bath are also explained. A method to determine the porosity of the Ni deposit by means of a potassium-ferricyanide test is described. Ni anodes should be annealed before use to assure a good solubility.
Ha (7a)

Lead and Lead-Antimony Anodes for Chromium Plating. E. M. BAKER & P. J. MERKUS. *Preprint, Transactions Electrochemical Society*, Vol. 61, Apr. 1932, pages 23-29.
For chromium plating from the chromic acid bath the pure Pb anodes are most resistant to corrosion with continuous operation; Sb-Pb anodes are most resistant with intermittent operation (2 min. on, 1 min. off; or 16 hrs. on, 8 hrs. off). Up to 12.5% Sb in the alloy, the corrosion loss in g./amp.-hr. bears a straight-line relationship with the Sb content of the alloy. For continuous operation, the anodic corrosion increases from 0.0085 g./amp. hr. for pure Pb to 0.0093 g./amp. hr. for 12.5%-SbPb. In intermittent operation, the anodic corrosion decreases from 0.01 g./amp. hr. for pure Pb to 0.0074 g./amp. hr. for 12.5% SbPb. The curves plotted from these results intersect at 5.2% Sb. With other modes of intermittent operation, the longer the idle interval in comparison with working interval, the heavier will be the corrosion on pure Pb anodes, but the faster will this corrosion decrease as the Sb content is increased. The presence of Sb up to 12.5% in the Pb anode does not interfere with equilibrium concentration of trivalent Cr. The bath used by the authors was 2.5 Mol CrO_3, 0.025 Mol H_2SO_4, temperature 45° C., anode current density 10.5 amp./dm.^{2}
LCP (7a)

Chromium Plating. E. J. DOBBS. *Journal Society of Chemical Industry*, Vol. 49, Mar. 28, 1930, pages 161-165T.
A general review of the Cr plating process.
VVK (7a)

Rhodium Plating Process Shown to Platers. *Brass World*, Vol. 27, Sept. 1931, page 201.
Sigmund Cohn, 44 Gold St., N. Y. C., has shown a process operating at room temperature for Rh plating. Rh deposits show high resistance to abrasion, and may be applied to Cr, Fe, Sn, Cd, Pb, Sb, and such soft metals as Britannia white metal, etc., after preliminary plating with Ag, Ni, Cu, Au or other metal. The plating outfit is illustrated.
WHB (7a)

Nickel Plating Die Castings. J. T. GILMORE. *American Machinist*, Vol. 75, Aug. 13, 1931, page 265.
The treatment of the pieces before plating is briefly described and the precautions necessary to avoid peeling of the plate are explained.
Ha (7a)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Sprayed Molten Metal Coating Process and Results. RICHARD L. BINDER. *Journal Franklin Institute*, Vol. 210, Aug. 1930, pages 173-217.
The Metalayer process of metal spraying, using oxy-acetylene, is described. The application of metal coatings to a large variety of objects is shown by photographs. The following metals and alloys can be applied: Zn, Al, Pb, Sn, Cu, bronze, Cd, brass, Ni, Nichrome, Monel metal, Fe, steel, Au, Ag, phosphor-bronze, Se, Mn, and Ta.
Ha (8)

Manufacture and Uses of Nickel-Clad Steel Plate. WILLIAM G. HUMPTON, F. P. HUSTON & ROBERT J. MCKAY. *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 123-124.
Abstract of a paper presented at a meeting of the American Institute of Mining & Metallurgical Engineers, held in New York, week of Feb. 16, 1931. See "Nickel-Clad Steel Plate Work," *Metals & Alloys*, Vol 2, Nov. 1931, page 260.
JN (8)

The Adherence of Zinc Coatings. WILLIAM H. FINKELDEY (Singmaster & Breyer, Consultants). *Metals & Alloys*, Vol. 2, Nov. 1931, pages 266-271.
2 divisions of this problem are adherence of the molten Zn to bare iron or steel and the subsequent adherence of the coating under deformation. With proper care in pickling and fluxing the molten Zn will wet the base readily when it reaches the temperature of the Zn bath. Defects traceable to inadequate adherence of the molten coating material in Sn and other plating operations are not experienced with Zn. The problem of an adherent coating to withstand deformation after application is far from simple in the case of Zn. The structure of the Zn coating is discussed and the bearing of these features on the adherence of the coating is shown. Even contour of the layers of the coating is superior to irregular layers in adherence under bending. Generally light coatings are superior to thick ones. The effect of temperature on the growth of Fe-Zn alloys, rate of cooling, Zn bath composition and composition of the base on the adherence of the coating are discussed. C content of 0.6% in the base is conducive to ductile, adherent coatings. Rephosphorized steels of medium C show good coating characteristics. Cracking of the coating is not necessarily a fault as long as peeling does not occur. Zn apparently offers an electro-chemical protection to iron against corrosion and small discontinuities do not impair this protection. The "galvannealing" process is described in which the fluid Zn is converted into the Fe-Zn alloy and no thin layer of Zn remains to peel from the surface and good adherence is obtained.
WLC (8)

New Lead Coating Process. *Brass World*, Vol. 27, Nov. 1931, page 238.
The "Leadhesion" process is commercially applied by the Gross Engineering Corp., Cleveland, Ohio, and is peculiarly applicable to the wide range of tanks, vacuum and pressure vessels, and moving parts of acid-proofed or brine-proofed machinery, etc. The process offers certain technical refinements over the present lead-coating processes.
WHB (8)

Use of Alloy Steel More Diversified. J. D. Knox. *Steel,* Vol. 88, Jan. 1, 1931, pages 252-254.

The automobile builders were the first to use alloy steels in quantity. Now, the petroleum, agricultural, machine tool, chemical, railroad and other industries are important consumers. The use of alloy steel forgings is on the increase in all industries. The chemical and allied industries are using increasing amounts of heat and corrosion resisting alloys of Cr and Ni. These alloys are being widely used also for the interior and exterior decoration of large buildings. Larger amounts of tungsten carbide are being used for tool steels and cutting materials. JN (9)

Development of the Welded Fire Box Heating Boiler in Canada. Clifford W. Morgan. *Canadian Machinery,* Vol. 42, Nov. 12, 1931, pages 38-44.

The introduction of the low pressure welded steel firebox boiler, embodying in later types a simplicity of design which ensures a high standard of durability and low operating costs, marks a new era in heating design and construction. Several new types of welded firebox boilers are described and shown by a number of drawings. WAT (9)

Light Alloy Pistons. H. J. Maybrey. *Automobile Engineer,* Vol. 21, Sept. 1931, pages 351-352.

Lightness, mechanical strength at working temperatures, wearing properties, high thermal conductivity, low coefficient of linear expansion, cheapness must be considered in the selection of material for pistons. This article notes, however, that, beside these physico-chemical considerations, the thermal point of view (that is, transferring the heat from the zone of high temperature as quickly as possible) enters into the satisfactory solution of the problem. The investigations along this line of thought have led to the following points: no interior webbing must be employed to mechanically reinforce a weak crown; skirt and head of piston must be continuous; the material should satisfy a formula developed by the French Academie des Sciences which provides that thermal conductivity/density x coefficient of expansion becomes a maximum. A piston developed along these ideas is described. Ha (9)

The Design of Welded Steel Structures. X. H. A. McCreadie. *Welder,* Vol. 2, Aug. 1931, pages 1-6.

In this last instalment, some special constructions are discussed and ways for their calculation are given; for instance, gantries, and crane girders, stairs, piers, dock gates, steel carriage bodies. Ha (9)

Practice in Steel Construction (La Pratica delle costruzioni metalliche). F. Masi. Ulrico Hoepli Milan, 1921. Paper, 7 x 10 inches, 530 pages. Price 80 L.

The preface states that this has been written to fill a need for a technical handbook on structural engineering in the Italian language.

The metallurgical discussion of structural steel is very brief, and not very informative. It is stated that cast iron contains from 1.5 to 6% C. Acceptance tests are dismissed with very brief quotations from the Italian Standards. Design on the basis of use of the steels of higher elastic strength, such as Nos. 48 and 52, and the Si and Ni steels, is apparently well advanced in Italy.

The standards of the Italian railways forbid punching of structural steel, drilling or sub-punching and reaming being required. The book deals with riveted structures, only about 5 pages being devoted to welding and the use of welded assemblies.

The general principles of the mechanics of structures are given, and very many details of design discussed and shown in sketches, in regard to many types of buildings, bridges, cranes, towers, etc. The civil engineer will find this a very complete treatise, profusely illustrated.

H. W. Gillett (9) -B-

Development of Portable Mooring Masts for Dirigibles. Beran von Linden Lansdowne. *Iron Age,* Vol. 128, July 2, 1931, pages 18-20.

There are 3 types of masts: (1) mobile mast; (2) fixed-stubmast; (3) temporary stubmast. Strength of mast depends on size of airships and maximum wind velocities. Ultimate strength of mast should be greater than that of ship. Factor of safety of 2½-3 is ample. Attempts have been made toward international standardization of mooring mast cups and cones. VSP (9)

Steel Floors (Fussböden aus Stahlblech). *Die Schmelzschweissung,* Vol. 10, June 1931, page 140.

Discussion of the possible advantages and economy in using steel sheets for floors instead of wood and the required dimensions, supports, joints, etc. The costs for a floor of 75 mm. I-beams with 5 mm. steel sheets with fire proofing and a cork cover are given as RM 46 for one square meter. Ha (9)

Steel Metal's Important place in Great Modern Buildings. *Sheet Metal Worker,* Vol. 22, Oct. 16, 1931, pages 588-589.

Illustrations and descriptions of ornamental uses in hotels, etc. Ha (9)

The Application of Gas Welding in Art Craft (Die Anwendung der Gasschweisstechnik im Kunstgewerbe). *Die Schmelzschweissung,* Vol. 9, Oct. 1930, page 230.

Shows 2 examples of decorative art welding with gas flame. Ha (9)

Nickel Steel Boilers for New Canadian Pacific Locomotives. *Boiler Maker,* Vol. 31, Apr. 1931, pages 88-91.

The use of a nickel steel having a minimum tensile strength of 70,000 lbs./in.^{2} led to a 27% saving in weight of the barrel course plates against carbon steel boiler plate. Complete data for the locomotive are given. Ha (9)

Cast Steel or Cast Iron Grate Bars. *Boiler Maker,* Vol. 31, Sept. 1931, page 241.

In the locomotives of the United States, Canada and Mexico, only 6%, or a total of 4100 locomotives, have cast steel grates of different types. The large majority, 84%, use cast iron grates. Ha (9)

Metals to Use for Various Parts of Grinding Machines. *Edgar Allen News,* Vol. 10, Nov. 1931, page 992.

Where Mn steel is used for parts taking heavy wear or exposed to hammering, the hardening and flowing effect of this material under such loads must be taken into account in planning the method of bolting it together. Room for expansion must be allowed. Heat treated chrome steel is the most suitable material for grinding plates in ball mills, for partition diaphragms and end liner plates in tube mills. Ha (9)

Interesting Steel Castings for Mining Use. *Edgar Allen News,* Vol. 10, Oct. 1931, page 977.

One piece is a ladle of 7 tons; 7 ft. 6 ins. external, 5 ft. internal diameter; 6 ft. 11 ins. deep; wall thickness 2.5 ins. The other is a bale of 2.75 tons; 7 ft. 1⅛ ins. diameter at the top, 6 ft. 2 ins. diameter at the bottom; 2 ft. 1½ ins. deep. The material is a C steel of 32/36 tons tensile strength with 15% elongation in 2 ins. Ha (9)

Copper Steel in the Manufacture of Locks, Hinges and Similar Wares (L'Acier au Cuivre dans la Confection des Serrures, Charmieres et Materiél Similaire). *L'Usine,* Vol. 40, Oct. 2, 1931, page 11; *Cuivre et Laiton,* Vol. 4, Aug. 30, 1931, page 387.

The use of copper steel in the manufacture of hardware has increased considerably in France because of its rust-resisting qualities. Ha (9)

Plated *vs* Solid Sheets. *Brass World,* Vol. 27, July 1931, page 159.

Well made plated sheets are more economical to use than solid sheets. Examples of plated sheet applications are illustrated. WHB (9)

Arc Welded House Promises New Market for Steel. *Iron Age,* Vol. 128, July 23, 1931, pages 254-255.

A comparison of wood construction with welded steel construction (sills, studs and headers) showed $6720.00 for wood against $6744.00 for steel. The houses have a brick veneer. Ha (9)

Delicate Foods Protected by Lead or Lead-Tin Foil. *Brass World,* Vol. 27, Oct. 1931, page 221.

Pb-foil is used for the protection of tea-leaves against air and sunlight. Pb-Sn foil is produced by rolling a slab of Pb and a slab of Sn in juxtaposition and the 2 gradually reduced to foil, maybe as thin as 0.001 in. This foil is used where the foodstuff cannot be allowed to come in contact with Pb. WHB (9)

Compares Tungsten and Tantalum-Carbide Cutting Tools. *Iron Age,* Vol. 128, Oct. 29, 1931, page 1113.

A brief discussion of the usefulness of this product in other fields of the steel industry, although it is not made in large quantities itself. Ha (9)

British Aluminium Co., Ltd. *Metal Industry,* London, Vol. 38, Apr. 10, 1931, page 378.

A recent development is the use of aluminum alloy pistons in large Diesel engines. The electrical and building industries consume considerable aluminum. PRK (9)

The Making of Mirrors by the Deposition of Metal on Glass. *Bureau of Standards Circular* No. 389, 1931, 17 pages.

This circular has been prepared in response to numerous requests for instruction concerning the preparation of mirrors. The directions are very explicit and are based on the experience of the Bureau over a number of years. The account of the chemical deposition of silver on glass is dealt with in considerable detail, but the methods are also given for the production of reflecting films on glass by the chemical deposition of copper, gold, platinum, and lead sulphide, by cathode sputtering and by the condensation of vaporized metals. WAT (9)

Reading Builds 20 Steel Cabooses. *Railway Age,* Vol. 91, Aug. 8, 1931, page 203.

20 caboose cars are now under construction by the Reading at its Reading, Pa., car shops. The new cars are of all steel construction, equipped with a one piece cast steel underframe, overall length 33 ft. 10 in. Berths and lockers are arranged under the lookout compartment for 6 persons. WAT (9)

Ultra-Violet Reflecting Power of Hyb-Lum. Notes from the U. S. Bureau of Standards. *Journal Franklin Institute,* Vol. 211, Jan. 1931, page 116.

Brief note on "Hyb-Lum," alloy of Al, containing about 2% alloying elements, chiefly Ni and Cr group metals. It is used in therapeutic lamp reflectors. DTR (9)

Truck Tanks of Aluminum Eliminate Scale and Increase Pay-Load 24 Per Cent. *Automotive Industries,* Vol. 64, Apr. 1931, page 551.

Light metal can be safely used for truck tanks for transporting gasoline. In addition to tank, underframe is made of Al structural shapes. A 1400 gal. Al tank weighs 1200 lbs., and capacity load weighs 8680 lbs. Similar steel tank capacity would be 1200 gal. The extra cost of the Al tank ($1000) is made up due to transportation of less dead weight in 2/3 year. Also, it does not scale on the inside of tank, and gasoline will be kept cleaner; by giving the outside of tank a coating of clear lacquer, less heat is absorbed and thus the loss through evaporation cut down. DTR (9)

Use of Duralumin in Strut Attachment to an Upper Wing. *Aviation,* Vol. 30, Sept. 1931, page 555.

A number of interesting constructional features are noted in the attachment of the outer bay struts to the upper wing panel of the new Consolidated Model 21-A Trainer, built by the Consolidated Aircraft Corp. The ribs are formed of heat-treated duralumin. The chord members, both top and bottom, are of a modified channel cross-section with wide, turned back flanges. The web members are straight rolled channels and are assembled to the chord members by riveting with duralumin rivets. Short spacer tubes are used around the rivets to prevent crushing the channels. Completed ribs are assembled by sliding over the spars and are held in place by nailing directly into the wood. DTR (9)

HEAT TREATMENT (10)

Annealing (10b)

Electrically Heated Annealing Furnaces for the Steel and Other Industries. J. C. WOODSON (Westinghouse Elec. & Mfg. Co.). *Iron & Steel Engineer,* Vol. 8, Mar. 1931, pages 122-128; *American Metal Market,* Apr. 3, 1931, pages 3, 5; *Heat Treating & Forging,* Vol. 17, Mar. 1931, pages 285-288, 291.

Paper read at Convention of American Institute of Electrical Engineers, March 1931. Thorough applications of electric annealing furnaces in ferrous and non-ferrous industries. DTR+WHB+Ha (10b)

The Annealing of Steel (Beitrag zur Untersuchung über das Entharten von Stahlen). P. CHEVENARD. *Metallbörse,* Vol. 20, Aug. 16, 1930, page 1828.

The hardening of steel was investigated by means of photomicrographic magnetic and dilatometric methods. Dilatometric curves were determined for the thermic cycles of growth with gradually increasing temperatures and also for the phenomena of isothermic growth under exact determination of the change of length as a function of the time. A special dilatometer with movable photographic plates was used. Constant temperature was insured by special construction. The investigations were made on austenite, the only constituent that can be obtained in a pure state. It was investigated in the state of complete super-hardening. A mixture of austenite-martensite was investigated in a partially superhardened condition and the greatest hardness obtainable was determined in a quenched steel containing the maximum amount of martensite. The phenomena can be explained by the equilibrium diagram but they are complicated by the simultaneous occurrence of the various reactions. The author could eliminate the influence of the simultaneous reactions which had caused the variations of results before. Austenite can lead to the formation of cementite, a reaction which causes contraction, or a mixture of Fe and cementite may be formed under expansion. The formation of martensite, which follows that of austenite, is connected with a contraction that grows with the temperature. In quenched steels there is always a simultaneousness of these 2 phenomena, causing in certain sections of the expansion curve either an arrest in the contraction, a rise, or a slowing down. A direct transition of austenite into martensite during heating could never be observed. This secondary reaction in hardening always occurs in the second period of cooling. This simultaneousness of the phenomena in martensite and austenite can also be observed by means of the electric conductivity. WHB (10b)

Effects of Annealing on Chains. *Heat Treating & Forging,* Vol. 17, Apr. 1931, pages 360-364; May 1931, pages 468-472; June 1931, pages 582-585, 588.

The report of the American Society of Safety Engineers on classification of chains, types, nature of service, annealing temperatures and times, fatigue, static strength and shock strength, effects of cold work, load tests, etc. Ha(10b)

Case Hardening & Nitrogen Hardening (10c)

Modern Case-Hardening Practice. FR. W. ROWE. *Iron & Coal Trades Review,* Vol. 122, Mar. 13, 1931, page 441.

A general discussion of the nature, the method, manner of performing, carburizing compounds, quenching oils, nitrogen hardening and the recent improvements of this latter process by the use of catalysts. See *Metals & Alloys,* Vol. 2, Oct. 1931, page 220. Ha (10c)

Relation of Structure to Surface Hardness of Case Hardened Steel. H. W. MCQUAID & O. W. MCMULLAN. *Metal Stampings,* Vol. 4, Mar. 1931, page 220.

Paper presented at the annual convention of the American Society for Steel Treating held at Chicago, Ill. See *Metals & Alloys,* Vol. 2, Oct. 1931, page 220. JN (10c)

Electric Carburizing Saves Labor of Eighteen Men. E. F. DAVIS (Warner Gear Co.). *Electrical World,* Vol. 98, Nov. 7, 1931, pages 827-828.

An abstract. The major saving of continuous annealing is in faster machining speeds and feeds, lower tool expense, the reduction of rejects due to noisy gears and the general improvement in production conditions. The continuous furnace is not for the small job shop. Furnace development is needed to eliminate roughing operations. WHB (10c)

What the Heat Treater Should Know about Nitriding of Steel. GEO. M. ENOS. *Fuels & Furnaces,* Vol. 9, Jan. 1931, pages 71-80.

The most practical advantage of nitrided steels is their extreme wear resistance. A brief history of the development is given; the nitriding process is explained; the equipment required for nitriding and the steels suitable for this process, the control of the process, testing for hardness and the physical properties of nitrided steels before and after nitriding, the Fe-N system and practical results are discussed and described. Ha (10c)

Carburizing Steels—Benefits Conferred by Alloying Metal. *Iron & Steel of Canada,* Vol. 14, May 1931, pages 87-88.

A discussion, republished from Vancoram Review, of the various types of carburizing steels which have been developed, with particular reference to the Mn-V steels in this connection. OWE (10c)

Gas Carburizing Apparatus. *Journal Franklin Institute,* Vol. 211, Mar. 1931, pages 367-371.

Abstract of *Franklin Institute Report* No. 2893, Oct. 1928. Low carbon steel carburized at 1500-2000° F., in contact with illuminating gas or solid charcoal. The exposed surfaces of the steel absorb about 1% of C to a depth of 1/64 to 1/16 in.; the core or middle portion retaining the original lower percentage of C. The parts are suddenly quenched and acquire a hard case or skin fit to resist wear and a tough core to withstand shock and give the necessary strength. Sketches show Machlet's improved carburizing apparatus. DTR (10c)

An Appraisal of Nitriding. M. A. GROSSMAN. *American Machinist,* Vol. 74, June 18, 1931, page 955.

Review. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 264. Ha (10c)

The Value of Nitriding. *Metallurgia,* Vol. 4, Aug. 1931, pages 123-124.

A general discussion of the method and its application. JLG (10c)

Nitriding Becomes Accepted Heat Treating Method. *Steel,* Vol. 88, Jan. 1, 1931, pages 282-283, 294.

Nitriding is now established as a low temperature hardening process and is being employed on larger castings and on greater quantities of steel. Cost reductions have been accomplished by the use and development of continuous and semi-continuous nitriding furnaces. The problem of containers has been brought close to solution by the development of enameled nitriding pots. A malleable cast iron has been developed which can be successfully nitrided. Short-time nitriding of common steels has been utilized for preventing corrosion. Improvements are seen in methods of sealing furnaces, in quenching systems, and in the greater use of gas-fired furnaces. The use of nitrided alloy tool steels and of nitrided steels in general is increasing. JN (10c)

Nitriding of Iron and Iron Alloys. W. EILENDER & O. MEYER. *Iron Age,* Vol. 128, July 23, 1931, page 255.

Abstract translation of an article in *Stahl und Eisen,* Jan. 29, 1931. Discusses the effects of nitriding on the surface hardness and the structure of Fe and its alloys with C, Al, Cr, Mo and V. See also *Metals & Alloys,* Vol. 2, Sept. 1931, page 177. VSP (10c)

Present Position of Nitralloy in Industry. M. A. GROSSMAN (Illinois Steel Co.). *Metals & Alloys,* Vol. 2, Sept. 1931, pages 150-154.

A paper read before the Washington-Baltimore Chapter, A. S. S. T. The author discusses the manufacture and treatment of nitralloy and the advantages of its use. The disappointments with it are recounted. The economics of the alloy and process are discussed. The paper deals with only one nitralloy, Cr 1.50%, Mo 0.20%, and Al 0.70% with varying C content. WLC (10c)

The Influence of Metallic Coatings on the Mechanical Properties of Steel in Nitriding (Der Einfluss metallischer Ueberzüge auf die mechanischen Eigenschaften von Stahl beim Nitrieren). TADAMASA YOSIKI. *Scientific Papers of the Institute of Physical and Chemical Research,* Tokyo, No. 292, 1931, pages 143-154.

The tests were made on a steel of 0.3% C which, after annealing, was nitrided at 650° C. by disintegration of ammonia gas from 10 min. to 1½ hrs. The tensile strength increased with time; elongation was reduced at first, then remained constant. After tinning, the same sample was again treated in the same manner; both tensile strength and elongation showed a diminution. Coating with different metals again showed that nitriding cannot be done with as good results as in the sample which is not covered. A chromium-nickel steel showed the same behavior under impact tests: the nitrided surface was removed by tinning and the improved properties decreased. From the results, it can be concluded that the very thin layer of iron nitride formed during nitriding greatly influences the mechanical properties of steel. 12 references are cited and a plate of micrograph illustrate some of the tests; the numerical data for them are given in tables. Ha (10c)

Carbonal Hardening. GEO. TURNER. *Automobile Engineer,* Vol. 21, Sept. 1931, pages 353-354.

Description of an electric resistance carburizing furnace for routine operation. Ha (10c)

A Practical Method of Obtaining the Depth of Carburized Case. J. SORENSON. *Fuels & Furnaces,* Vol. 9, Mar. 1931, pages 329-331.

The Brinell hardness test was used for determining the depth of the case. Tables show the values for carburized steels in 1/32 in., 3/64 in. and 1/16 in. depth. Ha (10c)

Energizing Action of Various Chemicals in the Carburization of Steel with Solid Carburizing Agents. R. A. RAGATZ & O. L. KOWALKE (Univ. of Wisconsin). *Metals & Alloys,* Vol. 2, Nov. 1931, pages 290-296.

5 references. Current theories of the action of energizers in carburizing are discussed. Compounds of the 8 groups of the periodic system were studied under described conditions. The energizing effect is not dependent upon the evolution of CO_2, but is a function of the properties of the metallic oxide portion of the energizer. Compounds such as calcium and magnesium carbonates which evolve considerable CO_2 are inert, while materials without evolution of CO_2 have marked energizing effects. Compounds of Cr, Mo, W, Mn, Fe, Ni and Co without the presence of any alkali or alkaline earth metals act as energizers. The inhibiting actions Sn, Bi, Sb and Pb are discussed. Carbonates of Na and Ba are the cheapest and strongest energizers. WLC (10c)

Malleableizing (10g)

Accelerated Annealing of Malleable Cast Iron. (Recint accéléré de la fonte malléable.) V. V. OUSSOV & N. N. POUSTYMYKOV. *Vestnik Metallopromychl,* Vol. 10, June 1930, pages 97-103; *Chimie & Industrie,* Vol. 25, Feb. 1931, page 352.

The American process is too long, requiring 100-120 hrs. The General Electric Company has succeeded in reducing the time required to 28-30 hrs., but this requires the use of electrical furnace. The authors have endeavored to render the process suitable for application in ordinary case hardening furnaces. Their work has shown that (1) in order to accelerate graphitization of the free cementite, it is merely necessary to keep the iron above 1000° for 2 hrs., at the end of which time the metal consists exclusively of the solid solution and of graphite; (2) to reduce the time required for graphitization of the cementite which separates on cooling, the metal must be cooled rapidly to 710° and maintained 4 hrs. at this temperature to decompose the pearlite formed by cooling into ferrite and graphite. This process required only 8-10 hrs. in the laboratory and 16 hrs. in a petroleum-heated muffle furnace. WHB (10g)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

The Weldability of Carbon Steels. (Ueber die Schweissbarkeit der Kohlenstoff-Stähle.) D. Seferian. *Schmelzschweissung,* Vol. 10, Nov. 1931, page 263; *Revue de la Soudure Autogene,* Vol. 22, No. 201, pages 2135-2140.

For the identification of steels from the metallurgical point of view, Grandon has developed a general formula for a welding coefficient which states that the weldability of ordinary steels is inversely proportionate to the C content. The following table is given:

Carbon content	Kind of steel	Welding coefficient	Weldability
up to 0.25%	very soft and soft	1-0.9	excellent
0.25-0.50%	semi-soft and semi-hard	0.6-0.5	moderate
0.50-0.80%	hard and very hard	0.3-0.1	not weldable

This factor can be used in the formula of Lame for the calculation of the thickness of welded tanks: $T = a\ Pd/2e$, where T is the safety factor of the steel, P the pressure to which the tank is subjected, d the diameter, e the wall thickness and a the welding coefficient of the table. The formula has, in many instances, been found to be satisfactory, but it is especially mentioned that it is applicable only with the welding methods and materials of our present knowledge. Probably, further developments in methods and in the flame of welding torches may tend to increase the welding coefficient. Ha (11c)

Butt-Welding Joints Having a Cross-Section of Eighteen Square Inches. M. Thomson. *Machinery,* Vol. 37, July 1931, pages 833-834.

The heated faces of motor frame rings are heated and forced together under a suddenly applied hydraulic pressure of 100,000 lbs., thus insuring a homogeneous weld. Ha (11c)

The Application of Welding to Armament. John W. Slattery & W. W. Ransom. *Army Ordnance,* Vol. 12, Nov.-Dec. 1931, pages 202-205.

Description of examples of repairing or reinforcing corroded or overstressed parts of ordnance by electric cutting and welding. The equipment of the Rock Island Arsenal is described. Ha (11c)

Oxwelding in Plant Maintenance. *Oxy-Acetylene Tips,* Vol. 9, Dec. 1930, pages 91-96.

The importance of a central welding department to plant operation is pointed out and illustrated by examples of automobile factories, oil refineries, refrigeration, foundries and steel plants, electric railways, etc. Welding should be organized on the same basis as other industrial plant maintenance activities. Ha (11c)

Ocean Outfall Oxwelded. *Oxy-Acetylene Tips,* Vol. 9, Dec. 1930, pages 86-87.

Description of welding and installing a wrought-iron pipe line for sewage disposal in the ocean. Ha (11c)

Welding Sequence Highly Important in Structural Members. *Electrical World,* Vol. 98, July 11, 1931, page 68.

The new Southern California Edison building in Los Angeles, Cal., was designed to be earthquake-proof and, therefore, was designed for horizontal forces as well as vertical loads. Floor beams were riveted and then electrically welded to the vertical H column so that full beam strength would be developed in the floor members. Electric welding was employed because of saving in material and the more compact detail of the welded connections. WHB (11c)

Cutting Risers with Oxy-Acetylene. *Metallurgia,* Vol. 4, July 1931, pages 91-92.

Runners, risers and fins can be economically cut from steel castings by means of the oxy-acetylene torch. This method of cutting is applicable to both large and small castings. Large castings should be heated before cutting and should be annealed after cutting. The blowpipes should be chosen with care. JLG (11c)

Electric Railways Use Oxy-Acetylene Welding. *Oxy-Acetylene Tips,* Vol. 10, July 1931, pages 115-119.

Illustrates several uses in power plant and rolling stock repair and maintenance which offered great savings. Ha (11c)

Strength of Welded Joints. *Aviation,* Vol. 30, Jan. 1931, page 63.

Abstracted from *N. A. C. Technical Report* No. 348. Gives information on strength, weight, and cost of types of welded joints. DTR (11c)

Bronze Welding Worn Overhead Frogs. *Electric Traction,* Vol. 27, June 1931, page 296.

A brief note on the results of service tests made by the Toronto Transportation Commission on the welding of worn overhead trolley frogs. It has been proved that worn parts built up with bronze, using an oxyacetylene blow-pipe instead of an electric arc will wear as long as new parts, and parts so built-up are readily ground. Parts electrically welded were ground with great difficulty and failed quickly in service. WAT (11c)

Fabrication Processes are Applied in New Fields. *Steel,* Vol. 88, Jan. 1, 1931, pages 280-281, 360.

New uses for electric and oxy-acetylene welding are seen in the manufacture of heavy-walled pressure vessels, in the joining of corrosion-resisting steels and in the construction of long-distance pipe lines. Electric resistance welding machines have been designed to join lengths of pipe in the shop and promise to become a factor in fabricated steel construction. Fusion welding has been applied to structural steel work and to the construction of pressure vessels. More cities are permitting the use of welded building construction. Progress has been made in the X-ray examination and other tests of welded joints. The use of riveting has also advanced. New applications of riveting are found in the fabricating of large traveling cranes made of Al and in all-metal dirigible construction. JN (11c)

The Welding of Saws. *Welding News,* Vol. 2, July 1931, pages 22-23.

Description of some cases of repairing big hand saws. Ha (11c)

The Autogenous Cutting of Structural Steels and Alloyed Steels. (Ueber das autogene Schneiden von Baustählen und legierten Stählen.) From the Research Laboratory of the Autogene-Works, I. G. Farbenindustrie A.-G. Frankfurt a. M. *Autogene Metallbearbeitung,* Vol. 23, May 15, 1930, pages 150-157; June 1, 1930, pages 166-173; June 15, 1930, pages 182-191; July 1, 1930, pages 205-210.

In cutting steel with a flame, the heat of the steel causes changes in the structure near the cut. 3 zones can usually be distinguished: an outer zone in which separation or accumulation occurs combined with a coarsening of the grain; an intermediate zone with a typical refined structure of a very uniform distribution of the C in the steel and fine grain; in the third zone, a transition to the structure of the material takes place. A great number of different steels have been tested and examined with regard to these changes and the physical-technical properties of the autogenous cuts. They are all described in detail and illustrated by micrographs, diagrams and tables. In conclusion, it is stated that autogenous cutting methods should be judged from 2 points of view: (1) the change of structure in the zones near the cut; (2) the appearance and the form respective of the cut. From the tests, no necessity could be found for structural steels up to 150 mm. to machine the cut afterwards on account of the change of structure. Autogenous cutting, in contrast to other machining methods, does not involve any forcible separation of the metal; the heat acts rather as a reinforcement which can be compared with surface hardening in a bath. Machining of the cut may sometimes lead to a deterioration of the material. Of still greater importance than the change of structure is the form and appearance of the cut. Autogenous cutting can be permitted without any objection if the surface is made smooth and straight. This appearance makes it possible to recognize immediately if cutting velocity and flame are properly adjusted and if segregations have taken place. 29 references supplement the paper. Ha (11c)

Recent Experience and Advance in the Utilization of Wheel-Set Built-Up Welding. (Neue Erkenntnisse und Fortschritte bei der Anwendung der Radsatz-Auftragsschweissung.) S. Sandelowsky. *Glasers Annalen,* Vol. 108, April 15, 1931, pages 149-154.

The paper takes the following steps: economy of the wheel-set built-up welding; strength and metallurgical properties; analyses of welding rods and material to be welded; influence exerted by carbon and by the speed of cooling down; pre-welding and welding voltages; significance of water cooling; economy of the welding of wheel axles. 10 illustrations. EF (11c)

Welding of Piping in New York Hospital—Cornell Medical Clinic. C. J. Thale. *Journal of the American Welding Society,* Vol. 10, Oct. 1931, pages 43-44.

Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. A brief review of procedure used on a large welding installation consisting of approximately 40,000 diameter ins. of welding. The types of piping welded were: high pressure steam piping for 200 lb. steam; medium pressure steam, 30 to 200 lbs.; low pressure steam, 5 lbs.; hot water heating piping; brine piping. Oxy-acetylene welding was employed; all the welding was done on the job. TEJ (11c)

Developments in Oxy-Acetylene Welding in Aircraft Industry. J. B. Johnson. *Western Machinery World,* Vol. 22, Oct. 1931, pages 451-453.

The past year has witnessed a great expansion in the aircraft industry. Several new factories have begun operations and many of the established factories have increased production. It is noticeable that oxy-acetylene welding has been adopted almost universally. The principal reason for the preference of oxy-acetylene welding over other methods is its adaptability to the welding of thin sections. The weld metal built up with a blow torch forms a smooth fillet and tapers off gradually into the base metal. This is not always true of weld metal deposited by other methods. In order to facilitate production some of the factories have installed acetylene generators and are piping acetylene and O to convenient locations in the plant. WAT (11c)

Patterson Steel Company Makes Employees Welding-Minded. J. A. Montgomery. *Welding,* Vol. 2, Oct. 1931, pages 676-678, 681.

These fabricators and erectors of structural steel taught the principles of arc welding to their employees. TEJ (11c)

American Experiences with Arc Welding (Amerikanische Erfahrungen auf dem Gebiete des Lichtbogenschweissens). *Die Schmelzschweissung,* Vol. 9, Mar. 1930, pages 58-61.

Description of some particular welds in marine practice and their tests. A large storage battery switch in a power station is also described and illustrations of some of the details of construction are included. Great economies in time and cost can be effected by welding bars and profiles instead of bolting them together. Tests with butt-welded plates of 6.3 mm. thickness showed the same good properties as welds with bevel. The first method was, therefore, admitted. Ha (11c)

In the Steel Plant; Oxygen Lance Cutting, a Routine Operation in the Production of Steel. *Oxy-Acetylene Tips,* Vol. 9, Dec. 1930, pages 83-85.

The oxygen lance method of tapping open hearth furnaces is economical and simple. One workman handles the lance while a second adjusts the pressure from a regulator on the drop line. The end of the lance is first put into the furnace until it is red hot. Then the oxygen is turned on gradually and the lance is placed against the plug in the tap hole and the oxygen pressure is gradually increased. In about one minute the plug is pierced. The use of the lance for removing hot tips from ingots is also described. It has also helped to save waste in reclaiming accumulated spills. Ha (11c)

Welding Practice on the Illinois Central System. *Boiler Maker,* Vol. 31, Jan. 1931, pages 9-12.

Instructions to welders and materials used and the current applied in arc welding are outlined. Ha (11c)

Report of Structural Steel Welding Committee. *Journal American Welding Society,* Vol. 10, Oct. 1931, pages 25-42.

First installment of a report by the Structural Steel Welding Committee of the American Bureau of Welding. The results of an investigation extending over a period of years which had for its principal object the determination of stresses that may be safely used in the designing of welded steel structures fabricated under ordinary commercial fabricating shop conditions. 2 sections of the report are included in this installment, consisting of an introduction and procedure followed in the tests. TEJ (11c)

Welding Standards. *Metallurgist,* Jan. 1931, pages 1-2.

The author questions the advisability of the comparatively recent movement to standardize welding. The movement has proceeded further in America than in England but he doubts if anyone is satisfied with the result achieved. "A number of non-destructive tests have been put forward—X-ray examination, electrical, magnetic and acoustical methods have all been proposed and tried with various degrees of success—but none of them as yet appear to have attained a status which would commend them to a British standardizing committee. Only the destructive tests remain, including a tensile or bending test on samples cut from a weld, and the examination of sections cut from the joint." Such testing is expensive in addition to producing a patchwork job that an engineer would hesitate to accept. "In many industries where testing technique is not yet fully developed, business is conducted on a basis of confidence between manufacturer and user. Many goods, even of an engineering character, are bought on the basis of the reputation of the manufacturer and the experience of the user without any rigid specification and with very little testing. While this method is difficult to apply or to maintain under modern conditions, there may still be a case for it as a basis for dealing with such a process as welding." VVK (11c)

The Autogenous Welding of Monel Metal. *Welding News,* Vol. 2, July 1931, page 21.

The essential points to be observed in the process are: size of blow pipe (75 litres acetylene/hr., maximum/ mm. thickness to be welded); perfect regulation of the flame with excess of neither acetylene nor O; use of a special cleansing flux applied to the filling rod and to the reverse of the edges to be welded. More or less rigid clamping of the edges according to thickness in order to reduce the effects of expansion and contraction as much as possible. A few suggestions to the beginner are given. In some cases, Ag brazing is preferable to welding because of the low temperature utilized, its mechanical properties and its resistance to oxidation. Ha (11c)

The Welding of Alloys; Oxy-Acetylene Process Adaptable to Ferrous and Non-Ferrous Metals. *Welding News,* Vol. 2, July 1931, pages 17-19.

The particular methods, precautions, flame adjustments, etc. are described for chrome and chrome-nickel steels, Mn steels, Mo, V and Si-Mn-Cr steels, Si irons, Al and its alloys, Ni and Monel metal, and Cu and its alloys. Ha (11c)

Dictionary of Welding Terms—English, German, Russian. (Fachausdrücke der Schweisstechnik—Deutsch, Englisch, Russisch.) Compiled by the Verein deutscher Ingenieure. VDI—Verlag, Berlin, 1931. Paper, 31 pages. Price 2 RM.

Welding engineers who want to keep informed about the development of their art must study not only the welding literature of their own country but that of foreign countries as well, but this is frequently very difficult because the standard technical dictionaries do not include welding terms which have come into use in the last few years. In order to remedy this condition the welding committee of the Verein deutscher Ingenieure has compiled a welding dictionary including Russian, German and English terms. It is intended to supplement the technical dictionary.
M. L. Moorman (11c) -B-

Repairing All-Metal Railway Coaches by Welding. A. J. T. Eyles. *Engineer,* Vol. 152, Aug. 14, 1931, page 168.

For permanent repairing of aluminum-paneled railway coaches, oxy-acetylene welding is recommended. Special technique and careful manipulation are required. Aluminum flux is used in the form of varnish on the welding rod. To secure homogeneity the welding rod used should be of pure Al. After welding, the weld joint and surrounding metal must be thoroughly cleaned to prevent corrosion. LFM (11c)

U. S. Navy Steps Out With Welded Boilers. *Power,* Vol. 73, May 12, 1931, pages 734-735.

To date the U. S. Navy has ordered 38 boilers with all welded drums. Detailed specifications for these boilers are described. They follow closely the A. S. M. E. code specifications published in the March 1930 issue of *Mechanical Engineering.* VVK (11c)

The Welding Processes. C. A. Adams. *Industry & Welding,* Vol. 2, Oct. 1931, pages 14-16.

The question today is not one of the process by which a weld is made but of its compliance with the engineering and economic requirements for the product welded. The use and particulars of gas flames, design and preparation of work, preheating, brazing and bronze welding are briefly discussed. Ha (11c)

Committee on Welded Rail Joints. Progress Report No. 7, May 1931. *Journal American Welding Society,* Vol. 10, Aug. 1931, pages 14-43.

A progress report of a joint committee of the American Railway Association and the American Bureau of Welding which was organized in 1931 to investigate the various types of welded rail joints in commercial use. The report includes a study of the heat effects of thermit welds on the adjacent rail material; the effect of preheating and postheating welded rail joints; repeated impact tests of joints; a study of butt joints and fish plate joints made with the atomic hydrogen process. The report also includes a study of stresses and distortion due to the heat of welding of low C to high C plates, by Professor T. R. Lawson (Rensselaer Polytechnic Institute). TEJ (11c)

How to Weld the Chromium-Nickel Steels. Part 2. S. Craig Alexander. *Welding,* Vol. 2, Oct. 1931, pages 684-687, 692.

Author gives details of oxy-acetylene and arc welding procedure for austenitic Cr-Ni steels. Expansion and contraction problems are pointed out and remedies suggested. Procedure is given for the welding of "18 and 8" to mild steel and galvanized steel. Directions are given for cleaning, grinding and buffing welds. TEJ+Ha (11c)

Resistance Welding Data. W. Anderson & Malcolm Clark. *Welding News,* Vol. 2, Oct. 1931, pages 28-29.

The 3 types of resistance welding are butt welding, spot welding and projection welding. They are described and the power consumption, size of transformers and speed of operation are given. Ha (11c)

Arc-Welding Large Cast-Iron Pots. Ernest Bauer. *Industry & Welding,* Vol. 2, Oct. 1931, pages 20-23.

Describes some repairs made by welding of cracks in 3 in. welds, thus salvaging expensive pots. Ha (11c)

Electrically Welded Stainless Tubing. J. S. Adelson (Steel and Tubes Inc.). *Welding,* Vol. 2, 1931, pages 689-692.

The author discusses the physical properties of resistance welded "18 and 8" tubing, a recent development. TEJ (11c)

Building Up Welding Fittings on the Job. F. S. Durham. *Welding News,* Vol. 2, Oct. 1931, page 25.

A brief description of welding pipe and fittings on the job. Ha (11c)

Use of Welding in the Fabrication of Stampings. A. F. Davis (Lincoln Electric Co.). *Metal Stampings,* Vol. 4, Apr. 1931, pages 347-350.

Deals especially with the use of arc welding for the assembly of heavy equipment from stamped and formed steel parts. A recent development in arc welding is an electrode known as "Lightweld," which is used in conjunction with a C electrode and permits the joining of metals as thin as 22 gage. Some applications of arc welding and stamping combinations are found in the fabrication of large steel winches and overhead tram-rail conveying systems. Advantages are lighter construction, greater strength and economy. MS (11c)

Fabrication of Chromium-Nickel-Iron Alloys. J. S. Ewing. *Proceedings American Association of Textile Chemical Colorists,* 1931, pages 13-15; *American Dyestuff Reporter,* Vol. 20, Jan. 5, 1930, pages 15-17.

Alloy containing 8% Ni and 18% Cr is austenitic in character, non-magnetic. Tensile strength 90,000 lbs./in.^{2}. Yield point 45,000 lbs./in.^{2}. Hot working range is 2150° to 1750° F. It can be arc welded, gas welded, resistance welded, or spot welded. (11c)

Aluminum Welding. *British Machine Tool Engineering,* Vol. 6, July-Aug. 1930, page 123.

The flux employed to dissolve the oxide formed when welding Al must operate at the temperature of fusion of the Al. A good flux for Al and its alloys should have a melting-point of approximately 590° C. One containing Li and potassium chlorides, potassium bisulphate, and potassium fluoride is recommended. WHB (11c)

Bronze Welds Superior to Cast Iron. W. A. Duncan. *Canadian Machinery,* Vol. 42, Oct. 15, 1931, page 44.

The reliability of bronze welding for cast iron pipe repair is satisfactorily illustrated. It is also claimed that this method is rapid and economical. WAT (11c)

A Welding Phenomenon of Increase of Notch-Impact Toughness of Autogenous Welds (Ueber einen Schweissvorgang zur Erhöhung der Kerbschlagzähigkeit autogener Schweissungen). H. Buchholz. *Autogene Metallbearbeitung,* Vol. 24, Oct. 1, 1931, pages 288-291.

The notch-impact toughness depends greatly on the treatment the material has undergone. Tests were made on an iron with 38.7 kg./mm.^{2} tensile strength and 27.5% elongation with an original toughness of 24 mkg./cm.^{2}. The welding seam was almost closed by one bead and a thin covering layer which closes the seam and at the same time anneals it. The tests proved that this annealing is sufficient to convert the insufficient notch-impact toughness of the coarse-grained super-heated weld structure (of the first process) into fine-grained structure which has high impact toughness. Properly carried out work can increase the toughness 4-5 times and, with hammering, even 7-8 times. The ratio of the notch impact toughness so obtained to that of the original material can be 50-90%. Right-handed welding gave, in general, better results than left-handed welding. Double V-welds do not show quite as high values as single V-welds, probably because of an overheating since the annealing cover layer has to be applied on both sides. Ha (11c)

Atomic Hydrogen Arc Welding. J. T. Catlett (General Electric Co.). *Metals & Alloys,* Vol. 2, Nov. 1931, pages 272-276.

The discovery that a stream of hydrogen passing through the electric arc is dissociated into the atomic rather than the molecular condition has led to a new process of welding. Hydrogen in this condition is very active and contact with comparatively cold surfaces results in the release of the energy imparted by the arc and under very reducing conditions which would assist in the purification of weld metal. The details of equipment for this type of welding are described and applications of the method are discussed. Microstructures of welded material are shown. Resulting welds are strong, ductile and remarkably free from porosity. Unusual welds are obtainable by the method; pure Zn, precious metals, W and even quartz may be fused. Pb burning is easily accomplished. Application to nitralloy has been successful. WLC (11c)

The Standard Testing Methods for Welds (Die normalen Prüfverfahren für Schweissungen). Kautz. *Schmelzschweissung,* Vol. 10, Nov. 1931, page 227.

General remarks on the making of tests; which tests—tensile, bending or shear tests—should be adopted; how the specimens should be prepared; non-destructive tests with X-rays and radium. Ha (11c)

Some Tests of Gas-Welded Structural Joints. H. H. Moss (Linde Air Products Co.). *Welding*, Vol. 2, Oct. 1931, pages 667-672.

Paper presented at the Annual Meeting of the American Welding Society, April 1931. Details of tests made to aid a Special Building Code Committee of Detroit in its consideration of the oxy-acetylene process during the revision of the city code. TEJ (11c)

Arc-Welding Steel Building Frames. Frank P. McKibben. *Canadian Engineer*, Vol. 59, Dec. 30, 1930, pages 751-752.

A list of 35 questions and answers on arc-welding for building inspectors. VVK (11c)

Progress in Structural Welding During the Last Five Years. Frank P. McKibben. *Welding*, Vol. 2, Sept. 1931, pages 602-604.

Within the past 5 years, over 100 towns and cities have modified their building codes to permit the use of fusion welding in steel building construction. Many other cities are considering adoption of similar ordinances. Elimination of noise is welding's greatest asset. Accurate cost data is difficult to procure. Automatic welding equipment can be used advantageously for shop fabrication if sufficient tonnage is obtainable to warrant its installation. The publication of a good, concise handbook for structural designers; the adoption of a code to permit welding in New York City; and the publication of the American Bureau of Welding's test data on welded joints, would accelerate the adoption of welding on building frames. Data regarding shop and field welding of a nineteen story office building, are included. TEJ (11c)

"Arcogen." The Combined Oxy-Acetylene-Electric Welding Process. *Welding Journal*, Vol. 28, July, 1931, pages 198-200.

Condensed from a lecture by Dr. Munter of Frankfort (Main) before the German Acetylene Association at Eisenach, Oct. 18, 1930. Description of a welding process developed by "Griesogen" of Frankfort, Griesheim, in collaboration with the A. E. G. of Berlin. The process combines the use of the oxy-acetylene torch and a metallic electric arc, securing the advantages of both. Concentration of heat and freedom from distortion result from the use of the arc while the acetylene flame protects the metal from oxidation. The method of operation is described and illustrated. Photographs show hot and cold bent and forged test welds. All materials which can be oxy-acetylene welded may be treated by the Arcogen process. TEJ (11c)

Welding of Copper and Bronze Pipe. H. V. Inskeep (Linde Air Products Co.). *Journal of the American Welding Society*, Vol. 10, Oct. 1931, pages 21-24.

Paper presented at the Fall meeting of the American Welding Society in Boston, Sept. 1931. Tests of experimental oxy-acetylene welds on different sizes of pipe and tubing show that the short bell and spigot joint best fulfills building water distribution requirements. The investigation included commercial red brass pipe, Muntz Metal pipe and copper tubing. Types of welding rod used were Cu, high strength bronze and ordinary bronze. TEJ (11c)

Arc-Welding for Automotive Shops. W. J. Chaffee. *The Battery Man*, Vol. 12, Oct. 1931, pages 23-26, 51.

The great adaptability of the arc-welding process in all types of repair work occurring in garages is noted and emphasized. Ha (11c)

To do Good Welding on Monel Metal. W. E. Warner. *Canadian Foundryman*, Vol. 23, Feb. 1932, page 8.

A very brief statement of methods that should be adopted in the welding of Monel metal, either by the oxyacetylene or by the metallic arc method. OWE (11c)

Welding Field Storage Tanks. E. E. Dillman. *Oil Weekly*, Vol. 63, Nov. 6, 1931, pages 40, 42, 44, 46, 48.

Tanks as large as 80,000 barrels in capacity may be constructed with all seams welded and all rivets eliminated from their construction. Process used is described. Diagrams, testing methods and specifications are included. (11c)

Pressure Welding of Low-Carbon Steels with Theoretical Considerations on the Mechanism of Such Welding. C. R. Austin & W. S. Jeffries (National Tube Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 451, Feb. 1932, 42 pages.

Describes an extended investigation of the factors influencing simple pressure welding. About 300 samples were welded by bringing the ends of rods together while at a welding temperature and applying definite pressures. The quality of the welds were determined by mechanical tests, macro- and microscopic examination and by measurements of the electric resistance. Welds were made in various atmospheres. It was concluded that satisfactory welds were dependent on breakage of the surface film. Many samples had high tensile strengths, but low shearing resistances, which was taken to indicate that welding had not resulted. It was concluded that simple pressure welding in air can not produce good welds. Detailed results are included in the several tables. 1 reference. JLG (11c)

Four Tunnels in New Arc Welded Water Line for San Diego. *Steel*, Vol. 88, Feb. 19, 1931, page 52.

A large transmission pipe line of 40 in. and 36 in. electrically welded steel pipe will bring water from the Otay reservoir to San Diego, Calif., a distance of 19 miles. This will supply 17,000,000 gallons daily. To construct the line, it was necessary to tunnel through four large hills. JN (11c)

Recent Developments in Oxy-Acetylene Welded Pipe Lines. D. E. Roberts. *Oil Weekly*, Vol. 61, May 8, 1931, pages 51-54.

Close procedure control, improved welding rod, better welding equipment, and new and improved methods of welding have all contributed toward the progress during 1930. (11c)

Future of Automatic Arc Welding in Boiler Work. G. H. Koch. *Boiler Maker*, Vol. 31, Feb. 1931, pages 34-36.

The mechanism used, speed of welding and different types of welds are discussed. The author believes that the all-welded boiler will soon replace the riveted boiler for high pressures. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 801. Ha (11c)

Automatic Arc Welding of Steel Sheets. A. M. Candy (Westinghouse Elec. & Mfg. Co.). *Metals & Alloys*, Vol. 2, Nov. 1931, pages 262-265.

Where the seams are simple and of reasonable length steel sheets may be advantageously welded by the automatic arc. Time delay in changing electrodes is reduced by the use of coils of wire automatically fed to the arc. The advantages of the automatic arc are summed up in economy and reliability. Equipment of this type of welding is described and applications are discussed WLC (11c)

How Welds are Tested. John H. Crowe, A. B. Kinzel & W. B. Miller. *Heating, Piping & Air Conditioning*, Vol. 3, Dec. 1931, pages 1021-1024.

Describes and explains the tests of oxy-acetylene welds, which consist of visual examination, hammer and anvil nick-break test, free bend test for ductility, tension test, Brinell and Rockwell hardness tests, specific gravity, stethoscope test, γ- and X-ray tests, compression and drift tests, and hydrostatic tests. WAT (11c)

Oxy-Acetylene Welding of Alloy Steels and Irons. J. H. Critchett (Union Carbide Research Lab.) *Metals & Alloys*, Vol. 2, Nov. 1931, pages 253-256.

Late years have seen many demands made by industry and met by the development of new alloy steels. Best known of these are the Cr and Ni-Cr heat and corrosion resistant steels. The wide use of these materials has led to extensive studies of their welding. The flexibility of the oxy-acetylene torch makes it readily adaptable to the special problems of many alloys. These alloys form infusible oxides resulting in porosity if an oxidizing flame is employed; a flame too rich in acetylene results in carburization of the weld and adjacent material with consequent loss of corrosion resistance. A neutral flame is essential. A flux is desirable which will dissolve iron and chromium oxide and produce a slag of proper viscosity to readily float the impurities. The technique of butt and flange welding is discussed. The problems of individual alloys are discussed under composition headings, 4-6% Cr, 12-16% Cr, 16-20% Cr, 20-30% Cr, 17-25% Cr-7-12% Ni, 7-25% Cr-17-22% Ni, 18% Cr-8% Mn, 1-2% Mn and 12% Mn steels are discussed. The necessity for flux and heat treatment in each case is discussed. Welding high Si cast iron is accomplished with proper flux and rod of the same composition. WLC (11c)

Flexible Welds in Metal Bellows. Thos. O. Ford. *American Machinist*, Vol. 75, Sept. 10, 1931, pages 423-424.

Welds of bellow plates formed by atomic hydrogen process are homogeneous with the original plate in structure and react similarly to heat treatment. The inside of the joint is partly filled with water; the nickel steel expansion element is arc-welded to forged flanges. The test method for the finished bellows is described. Ha (11c)

A New Process of Oxy-acetylene Welding. T. W. Greene (Linde Air Products Co.). *Journal American Welding Society*, Vol. 10, Oct. 1931, pages 19-21.

Paper presented at the Fall Meeting of the American Welding Society in Boston, September, 1931. A description of the recently developed Lindeweld process, features of which are special flame adjustment to give a carbonizing flame, a special welding rod and back-hand welding technique. Physical properties of welds are tabulated. TEJ (11c)

The Yale University Group of Welded Buildings. Gilbert D. Fish. *Journal American Welding Society*, Vol. 10, Oct. 1931, pages 9-12.

Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. A description of 4 completely arc-welded steel frame buildings being erected at Yale University. Bids on welded construction were about 13% lower than riveted. About 8 ft. of shop welding and 4 ft. of field welding was done/ton of steel. Erection seats and bolts were used. Some photographic illustrations of joints are included. TEJ (11c)

Riveting (11d)

Pin Riveting in Boiler Work. *Boiler Maker*, Vol. 31, Feb. 1931, pages 30-33.

This is a new process developed by the Skoda Works in Pilsen, Czechoslovakia. First, the shank material is uniformly and simultaneously forced from both sides into the rivet hole upon which the material flows into the countersunk portion of the rivet hole. The 2 heads are formed on the plates simultaneously as a purely metallic contact is realized, i. e., without the interposition of any foreign matter. Practice has proven that pin rivets which have been snapped in accordance with this patented method show a tightness of 99% and do not require any subsequent calking. A special device for setting these pin rivets is described. Ha (11d)

A New Riveting Method for Light Metals, in Particular for Refinable Aluminum Alloys (Ein neues Nietverfahren für Leichtmetall, insbesondere für vergütbare Aluminiumlegierungen). *Aluminium, Hauszeitschrift V. A. W. Erftwerk*, Vol. 3, Apr.-June, 1931, pages 160-166.

Hot riveting usually destroys the great hardness of high grade aluminum alloys and other means were sought for a method of riveting which conserves all good properties of the light metals. This is of particular importance in the construction of airplanes. Only a cold riveting method could fill these requirements; such a method is described and illustrated with rivets also of light metal. Many precautions are necessary to insure complete tight fitting of the rivets and rivet heads to the material. A table shows the dimensions of rivets, heads, riveting iron, physical properties of the material used. From tests of riveted joints, it can be stated that the strength of a riveted joint does not depend on the manner in which the rivet head is made but, rather, on the kind of alloy and the thermal pretreatment and on the dimensions. Under certain conditions, annealing can increase the mechanical strength, somewhat; in special cases, a high shearing strength can be obtained by a steel sleeve over the light-metal rivet. The sleeve is fully protected against corrosion by the rivet tightly surrounding it. Ha (11d)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Melting Gun Metal. *Electrical Review,* Vol. 108, May 8, 1931, page 808.
Fuel consumption tests on small gas-fired and oil-fired installations for about 300 lbs. charge gave, as average cost/day, 10.3 pence for the gas furnace and a consumption of 0.5-1.5 gal. of oil/100 lbs. melt for the oil-fired furnace. This compares very favorably with the operating costs of electric furnaces. Ha (12a)

Mixing Metals. *Metallurgist,* June 1931, pages 81-82.
The preparation of an alloy of definite composition by melting together the requisite metals would appear to be a simple matter but in practice certain difficulties and complications have to be overcome, and these vary from one case to another, according to the characteristics of the metals used and of the final alloy. The "secret methods" claimed by vendors of proprietary materials can, of course, be duplicated by any competent metallurgist. The claim that "natural" alloys, whose constituent metals were reduced together from the ores, possessed advantages over the same alloy produced synthetically has been shown to be due to the presence of small amounts of other metals which were not taken into consideration when the synthetic alloy was made. Among bronze founders, the opinion is rather widely held that repeated remelting is necessary in order to produce good, homogeneous metal. The disadvantages of remelting are the tendency to absorb gases from the furnace atmosphere, the introduction of oxides and other compounds from the gases and from the refractories, contamination during repeated charging and subsequent manipulations and the loss of metal by volatilization or by oxidation. The advantages are the elimination of dissolved gases from the metal if it is cast into fairly large ingots and allowed to cool sufficiently slowly to undergo gas-elimination by the presolidification process and that it secures improved mixing. The former potential advantage is lost if the metal is cast into small chill ingots. Thorough mixing can be obtained by improving the present inefficient stirring prevalent in the non-ferrous foundry. VVK (12a)

Open-Hearth Furnace Control Discussed at Symposium in Buffalo. *Iron Age,* Vol. 125, June 26, 1930, pages 1889-1890.
Papers were read by R. W. Simpson, Bradley and Joseph F. Shadgen. For best results with furnace control deeper checkers are needed. Temperature is a most important factor in the furnace operation. A high degree of preheat speeds up operations. Dynamic control increases production, decreases fuel consumption, gives a longer furnace life and better metallurgical operation. Furnace atmosphere is important. CO recorders in stack are not a very satisfactory measure of combustion for open-hearth furnaces. VSP (12a)

Open-Hearth Operators Talk over the Problem of Making Good Steel. *Iron Age,* Vol. 126, Nov. 27, 1930, pages 1623-1626; **Quality Control, Alloy Contamination in Making Open-Hearth Steel.** Dec. 4, 1930, pages 1701, 1745-1746; **Open-Hearth Men Consider Furnaces, Fuels and Mold Washes.** Dec. 11, 1930, pages 1777-1779.
From 13th semi-annual session of the open-hearth conference of the iron and steel division of the American Institute of Mining and Metallurgical Engineers at Cleveland, Nov. 20, 1930. Program was divided into 3 sessions, devoted to open-hearth operation, combustion control and quality control and also including a discussion of refractories. Use of superheated steam at about 650° F. showed a saving of 2 gal. of oil to a ton of steel as compared with steam for atomizing, but without superheat. Little advantage in superheat is noted, so far as flame temperature is concerned. Troubles with bifurcated spout may be avoided by keeping tapping hole of furnace straight. One operator uses tilting furnaces on account of high P content in his Fe. Large heats give a decided saving in operating cost, because there is less time required for each ton of steel; less bottom material; greater outflow of steel hourly, and labor cost lower for each ton. Time is gained in the making of a heat when a high percentage of hot metal is used in place of a high percentage of scrap. Size of ladles is increasing. Deep slag pockets are advantageous. Refractories suitable for use with temperatures of 3500° to 4000° F. are needed. Progress has been made in better silica brick. Rolling mill committee recommended beginning blooming with small draft, turning ingot 90°, after every 2 passes. Best results obtained by passing ingot through rolls at between 2150° and 2200° F. High S steel should be poured on "cold side" and rolled on "hot side." Liberal stirring with rods recommended in refining process. Progress report on alloy contamination of open-hearth steel was given by Dr. C. H. Herty, Jr. Cost of open-hearth roofs, close flame control is essential, advantages of using luminosity flames, mold and stool coatings were other topics discussed. VSP (12a)

Re-melting. *Metallurgist,* Nov. 1930, pages 162-163.
The present restrictions in current specifications on the use of scrap in the manufacture of brass should be retained; any variation therefrom should be arranged privately by the manufacturer and the customer. VVK (12a)

Rolling (12c)

The Arrangement of Passes on Stationary 3-High Blooming Mill Rolls (Ueber Anordnung von Kalibern auf festliegenden Trio-Blockwalzen). T. Dahl. *Stahl und Eisen,* Vol. 51, Oct. 1, 1931, pages 1228-1232.
The author shows that in rolling special steels on 3-high mills, the distortion of the rolled product is due to a non-uniform distribution of the upper pressure.
Generally speaking, an unsuitable arrangement of the passes on stationary 3-high rolls is sometimes to be found. The manner of obtaining an equalization and a diminishing of the upper pressure can be attained. The described method diminishes the distortion of the rolled stock. GN (12c)

Sheet Mill Practice. R. J. Wean. *Blast Furnace & Steel Plant,* Vol. 19, Feb. 1931, pages 261-263.
Discussion of the economies achieved by newer methods of continuous strip mills and the adaptation of existing equipment to meet present day competition without creating undue technological unemployment. A chart is given for figuring the possible savings. Ha (12c)

Shearing & Punching (12e)

Punching and Forming in the Strip. Chas. F. Smith. *American Machinist,* Vol. 75, Oct. 1, 1931, pages 522-523.
Discussion of the method best suited to least handling the strips and pieces punched from it. Ha (12e)

Machining (12g)

Greater Tool Life by Efficient Refrigeration. *Houghton's Black & White,* Vol. 3, Mar. 1931, pages 10-12.
A few practical suggestions for the arrangement for cooling tools and the selection of coolants. Ha (12g)

Turning Pistons. *Automobile Engineer,* Vol. 21, Apr. 1931, page 134.
A diamond-tipped tool is used on light alloys in cases where a high degree of finish is required. Ha (12g)

Progress in Milling Practice. *Automobile Engineer,* Vol. 21, May 1931, pages 194-195.
A few interesting examples of recent milling machinery which has speeded up production very considerably. Ha (12g)

Machinability of Metals. Alexander H. d'Arcambal. *Canadian Chemistry & Metallurgy,* Vol. 15, Oct. 1931, pages 270-271.
The relative machinability of steels is in the order: cold drawn Bessemer screw stock; open-hearth Bessemer screw stock; high-S; low-S; high-Mn; and basic open-hearth. The high machinability and finish of high-Mn steels gives them wide use in spite of their high cost. It is now believed that the coarser the grain the more readily machinable are the materials. High-Mn steels, sulphonated cutting oils, and Cr-plated tools are recommended. A field is seen for tantalum carbide-tungsten-carbide tool material. WHB (12g)

Milling with Tungsten Carbide Tools. *Engineer,* Vol. 151, June 12, 1931, page 659.
Brief comment on machining operation described in publication of Kearney and Trecker Corporation, Milwaukee. Milling is done with an inserted tooth cutter on a cast-iron pump body, one end of which must be faced. Due to its form, there are many interruptions but chipping of corners must be avoided. Compares performance of high-speed steel, Stellite, and tungsten carbide. Stellite feed per min. is 75% faster than high-speed steel. Tungsten carbide feed per min. is 170% faster than high-speed steel and 55% faster than Stellite. LFM (12g)

The Influence of Shape and Magnitude of the Section of the Chip on the Result of Measurements of Cutting Pressures on Turning Tools (Der Einfluss von Form und Grösse des Spanquerschnitts auf das Messergebnis bei Schnittdruckmessungen an Drehwerkzeugen). B. Windmueller. *Die Messtechnik,* Vol. 7, June 1931, pages 150-152.

At first it is shown how the pressure exerted on the tool in cutting the material is resolved into 3 components, the principal cutting pressure acting vertically, the feed pressure acting in axial direction of the working piece, and the back-pressure acting in transverse direction of the axis of the piece, usually in the direction of the cutting tool. The arrangements to measure these pressures by Taylor, Schlesinger, Losenhausen Okochi and Okoshi, and the measurement of the torque produced in cutting are described. It is shown that, because of the construction of these arrangements shape and magnitude of the chip influences the result. The inaccuracy due to this influence can be reduced by taking into account the depth of the cut. 2 examples illustrate the method. Ha (12g)

Machining Duralumin. John Younger & W. R. Jenkinson. *American Machinist,* Vol. 75, Aug. 13, 1931, pages 269-271.

A series of tests were made to determine the power consumption in machining both cast and wrought duralumin of 55,000-63,000 lbs./in.^{2} tensile strength and a Brinell hardness from 90 to 105. This material was used in place of steel, making possible a saving of about 3/5 of the weight. Cutting tests were made with different cutters and the horse power consumed measured at different speeds. Charts were made up showing the consumption at different speeds and feeds. Ha (12g)

Some Experiences with Tungsten-Carbide Tools. K. F. Smith. *Machinery,* Vol. 37, Feb. 1931, pages 415-416.

General remarks on feed, speed and angles of grinding as experienced in the Naval Air Station, San Diego, Cal. The output/man was greatly increased by these tools. Ha (12g)

The Cutting of Outer Threads with Automatically Opening Cutter Head (Das Aussengewindeschneiden mit selbstöffnendem Schneidkopf. Ein Beitrag zur Frage der Zerspanbarkeit von Eisen und Stahl). K. Schimz. *Archiv für Eisenhüttenwesen,* Vol. 5, July 1931, pages 35-44.

7 different materials with varying C, Si, Mn, P, and S contents were used during the experiments. The results show that the cutting of inner and outer threads are 2 types of machining which require different steels. The geometrical shape of cutterhead and dies limit the cutting performance. The performance is closely related to cutting velocity, cooling, angles of tool, diameter and properties of the material. Actual cutting is done by the teeth of the ground side. At low cutting velocities, the wear of the edge of the cutters is independent of the composition of the tool. Practical results with a cutting velocity of 6 m./min. show a torn surface at the end of the thread. The wear of the dies are in the first place dependent on the C content of the material. The increase of tensile strength caused by P is of minor importance. No relation exists between wear of the dies and length of the chips. The shortest chips are obtained with the highest C, P and Mn contents. GN (12g)

Optics in Metal Working. Ken G. Niblack. *American Machinist,* Vol. 75, Aug. 6, 1931, pages 225-228; Aug. 13, 1931, pages 272-273; Aug. 20, 1931, pages 307-309; Aug. 27, 1931, pages 346-347; Sept. 3, 1931, pages 380-382.

This series of articles explains the fundamentals of optical systems, magnification, deflection, refraction and describes in detail the instruments for testing materials and processes, such as micrometer microscopes, spectroscopes, contour projector, optical drill gage and optical flats. Ha (12g)

The Cutting Carbides. Frank W. Curtis (Kearney & Trecker Corp.). *American Machinist,* Vol. 74, May 14, 1931, pages 755-757.

Abstract of a *Society of Automotive Engineers Production meeting paper,* entitled "Latest Developments of Faster Milling with Tungsten and Tantalum Carbide Cutters." Discusses design of the milling machines, speeds and operating practices. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 313. RHP (12g)

Deep Drilling of Small Holes. J. T. Towlson. *American Machinist,* Vol. 75, Aug. 6, 1931, pages 248-249.

The drill is clamped into a chuck so that it protrudes only slightly and is fed by hand into the work. When the drill has penetrated the work as far as it can go, the chuck is screwed back and the drill is set out farther, thus drilling in steps. Ha (12g)

The Story of Carboloy. Part III. *Carboloy,* Vol. 2, May 1930, pages 2-4.

This installment deals with the proper setting of Carboloy (tungsten carbide) bits for tools and the best angles for cutting the different materials. The advantage of using larger shanks instead of small bits is pointed out. The bits are brazed by hydrogen-copper to the steel shank, with but very little Cu to be employed, but ample area must be provided for correct braze. Ha (12g)

Turning by Templet. *American Machinist,* Vol. 75, Aug. 13, 1931, pages 281-282.

Description of arrangement of templets. Ha (12g)

Drawing & Stamping (12h)

Machines for Hot-Forming and Stamping Nonferrous Metals. J. I. Bernitz. *Metal Stampings,* Vol. 4, Apr. 1931, pages 333-336.

Most commonly used machines for hot forming of nonferrous metals, particularly brass, are: (1) drop-hammer, (2) friction screw embossing press, (3) crank or eccentric shaft press and (4) hydraulic press. Drop-hammer has not been as successful with brass as with steel. It has a tendency to spread the material rather than to force it down into the cavities of the die. Almost any kind and size of hot forgings can be made on the friction screw press. Proper penetration to the center of the slug and the desired spreading effect are obtained with this press. Eccentric presses are limited to hot forming of small and medium sized articles requiring little deformation. Hydraulic press is suitable for materials which are handled at low temperature and require a slow deforming spread. MS (12h)

Experiments in Wire Drawing: The Drawing of Non-Ferrous Wires. Francis & Thompson. *Engineer,* Vol. 152, Oct. 2, 1931, pages 358-359.

Astract of a paper read before the Institute of Metals, Zurich, Switzerland, Sept. 15, 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 314. LFM (12h)

Testing Deep Drawing Qualities of Sheet Metal. H. W. Gillett. (Battelle Memorial Institute) and discussion by C. L. Eksergian (Budd Wheel Co.). *Metals & Alloys,* Vol. 4, Oct. 1931, pages 214-222.

73 references are cited. The variables involved in die and press design are enumerated and discussed, and the variables in the quality of the sheet metal. Various tests for hardness and deformation under standard conditions are discussed with reference to their control of the quality of sheet to be used. The standards of tests applicable to one plant or operation must be applied elsewhere with caution and careful study. Mr. Eksergian discusses specifically the manufacture of automobile parts by deep drawing. WLC (12h)

Pickling (12i)

The Pickling of Metals. *Heat Treating & Forging,* Vol. 17, Oct. 1931, pages 959-960.

Solutions, maintenance of acid solution, pickling time, temperature of baths and catalyzers are described. Ha (12i)

Makes Pickling Tanks of Rubber and Brick Linings. *Iron Age,* Vol. 128, Aug. 6, 1931, pages 378-379.

Vulcanized rubber in combination with steel and masonry is being offered by the B. F. Goodrich Rubber Co., Akron, Ohio. VSP (12i)

Cold Working (12j)

The Cold Finishing of Steel Bars. J. R. Miller. *Blast Furnace & Steel Plant,* Vol. 19, Feb. 1931, pages 264-267, 276; *Heat Treating & Forging,* Vol. 17, Jan. 1931, pages 40-43, 49.

Discussion of the manufacturing process for cold rolling and cold drawing and the cost for producing certain goods. The steel used in these processes is usually open-hearth steel of 0.26-0.32% C and 0.60-0.80% Mn. Ha. (12j)

Strain-Hardening of Plastic Metals. E. V. Crane. *Iron Age,* Vol. 128, July 23, 1931, pages 250-253; Aug. 20, 1931, pages 498-499, 543-545.

Plasticity of metals is essential as a prerequisite for press operations. How the physical properties of various metals usually used for such treatment are affected by repeated cold working is shown by diagrams and tables. Successive strain-hardening, followed by softening under annealing and, thus, working back and forth between a hard condition and a soft condition is explained and the limits to which strain-hardening may be safely carried are outlined and illustrated in curves for bronze, carbon steels, Cu and Al. It is essential that cold working does not go beyond the limit of plasticity, since, otherwise, fracture will result. Cold working, however, increases the elastic limit and also the yield point which are the vital elements in plastic working. Ha. (12j)

Lead Coatings as Lubricant in the Cold Working of Metals (Emploi du plombage dans le travail a froid des métaux). G. De Dudzeele. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 499-506. 8 figures.

In order to avoid annealing between passes and the loss of metal resulting from the necessary pickling, lead coating of seamless tubing and other cold-worked steel products, is advised. The Pb is not really a lubricant, since it takes slightly more power to cold work the lead coated products, but it prevents seizure of the tubing in drawing, and less lubricant is required. Seizure is especially notable with alloys high in Cr. Some high Cr steels can scarcely be worked without the lead coating. The Pb is applied by fluxing and dipping. It is applicable to brass, bronze, cupro nickel, nickel brass, etc., as well as to steel. In drawing tubes of 1% Cr, ¼% Mo, 4 passes on coated steel produced the same result as 5 passes on uncoated steel. Apparatus for hot-dipping to produce the lead coating is illustrated. Removal of the Pb is mentioned in the cost estimates tabulated, but the method of de-leading is not described. HWG (12j)

Machine for Cold-Forming Metal Strip. *Brass World,* Vol. 27, Sept. 1931, page 198.

A new method in cold-roll forming machinery for metals is announced by Kane & Roach, Inc., Syracuse, N. Y. The machine will manufacture a patented retainer strip, used in installing gypsum board. WHB (12j)

Cold Heading Die Life. A. S. Jameson. *Metal Stampings,* Vol. 3, Oct. 1930, pages 927-928.

Abstract of paper read before the American Society for Steel Treating, Sept. 22-26, 1930. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 272. MS (12j)

Cleaning (12k)

Cleaning Scale and Rust from Steel Parts. *Machinery,* Vol. 37, Jan. 1931, pages 375-376.

A "bright dip" electrolytic pickling process is described. The composition of the liquid is not given. Ha. (12k)

Electrolytic Metal Cleaning without Corrosion. *Chemical & Metallurgical Engineering,* Vol. 37, Oct. 1930, pages 634-635; *Metal Cleaning & Finishing,* Vol. 2, Oct. 1930, pages 899; *Maschinenkonstrukteur Betriebstechnik,* Vol. 64, May 10, 1931, page 111.

A new method, the Bullard-Dunn method, patented by the Bullard Company, Bridgeport, Conn., claims the purification of metal surfaces from oxides, scale, etc., which are present. It is suitable for iron and steel as well as for non-ferrous metals. MS&MAB (12k)

Cleaning (12k)

Trichlor-ethylene as Degreasing Material in the Metal Industry (Trichloraethylen als Entfettungsmittel in der Metallindustrie). GEO. WOLFF. *Oberflächentechnik,* Vol. 7, Aug. 19, 1930, pages 154-155.

The disadvantages of removing grease by boiling in lyes are explained. Trichlorethylene is a compound absolutely non-explosive and non-inflammable. It boils at 87° C. and, therefore, can be readily recovered by distillation from the grease and oil. It is superior to benzine in solving fats and oils, even rosin, pitch, sulphur, wax and paraffins. It does not etch or attack metals. If inhaled in great quantities, it has a narcotic effect with, however, no harmful after effects. Workmen, working with trichlorethylene, should be protected against inhaling. Installations for washing with this preparation and subsequent drying are described. Ha. (12k)

Polishing and Grinding (12l)

Sharpening Reamers. L. M. RICHARDS. *American Machinist,* Vol. 75, July 23, 1931, page 177.

Description of a method which removes the usual uncertainty of sizing, and increases the life between grinds tenfold. It is accompanied by circular grinding in the usual manner and then backing off to within 0.006-0.01 in. Ha. (12l)

Magnetic Chucks Keep Pace with Modern Surface Grinders. F. L. SIMMONS. *Iron Age,* Vol. 128, Oct. 29, 1931, pages 1114-1115, 1138.

The advantages of magnetic chucks for holding magnetic materials while being ground or polished are noted and a few constructions are illustrated. A much greater quantity of material may usually be handled in the same time that is required by mechanical holders. Ha. (12l)

Grinding Direct from the Drawing. O. P. VAN STEEWEN. *American Machinist,* Vol. 75, Sept. 3, 1931, pages 367-371.

Description of a machine which makes it possible to finish grind directly from the hardened piece the desired profile according to a drawing magnified 50 times, even if limited by straight or curved lines. It consists essentially of 3 parts, the work slide, grinding wheel head and pantograph with microscope and drawing board. The microscope facilitates observation of the work and the tool. The machine works accurately to microscopic tolerances. Ha. (12l)

Grinding Fixtures for a Threading Die. C. R. RANNEY. *American Machinist,* Vol. 75, Aug. 6, 1931, pages 241-245.

Detailed description of the precision tools for grinding threading dies and their set up. Ha. (12l)

Tool Grinding Control. P. E. GARLENT. *American Machinist,* Vol. 75, Oct. 15, 1931, pages 599-600.

A central system supplements the individual tool rooms that serve their respective departments so that uniform tool grinding throughout the plant is guaranteed. This system is in use at the Timken Detroit Axle Co. Ha. (12l)

Controlled Structure of Grinding Wheels. *Western Machinery World,* Vol. 22, Sept. 1931, page 399.

A new method employed by the Norton Co., of Worcester, Mass., for manufacturing grinding wheels, which makes possible finer refinement of grinding action and closer duplication of wheels is described. Regulation of the arrangement of abrasive, bond and pore space to produce a specific structure for a particular grinding operation, without changing the grain or grade is the essential feature of this new method. It permits about 12 structures without change of grade in a wheel, though for commercial practices not all of these are necessary or employed. The method is applied by controlling the volume percentage of the constituent parts of a wheel. WAT (12l)

Finishing Pipe Straps (Rohrschellenfertigung). KARL DEININGER. *Das Werkzeug* (supplement to *Maschinenkonstrukteur-Betriebstechnik*), Vol. 7, May 10, 1931, pages 105-106.

In producing pipe straps it is desirable that as few single operations as possible be necessary. The production of this attachment by means of a combined tool is explained, special attention being given to the present-day means of polishing. MAB (12l)

Cam Grinding. *Automobile Engineer,* Vol. 21, Feb. 1931, pages 64-65.

A recently introduced cam grinding attachment of the Churchill Machine Tool Co., Ltd., is described. It is arranged to give an even surface speed by retarding the rotation of the work as it swings away from the grinding wheel whilst accelerating the speed at the opposite motion. Ha (12l)

Advantages of Mechanical Lapping Over Hand-Lapping. *Grits & Grinds,* Vol. 22, June 1931, pages 2-7.

Tests made over 2½ yrs. with plug gages of 4 different manufacturers gave evidence that in every instance the mechanically lapped gage plugged more holes than the hand-lapped gage. It also indicates that the maintenance costs were reduced. Ha. (12l)

Photomicrographs Show Superiority of Mechanically Lapped Gages. *Grits & Grinds,* Vol. 22, June 1931, pages 7-11.

A collection of microphotographs taken of a hand-lapped gage that had to be discontinued after 8000 holes while the mechanically lapped gage stood up to 25,389 holes. Ha. (12l)

The Polishing of Aluminum and Brass. *Metal Industry,* N. Y., Vol. 29, May 1931, page 208.

The details are given for the rough and fine polishing of castings, etc., of aluminum and of brass. PRK (12l)

Dressing Rolls in Aluminum Rolling Mills by Hand Grinding. R. J. ANDERSON. *Rolling Mill Journal,* Vol. 5, Dec. 1931, pages 763-766.

The principles and practice employed in the maintaining of fine surface finish on rolls used for rolling Al sheet and foil are discussed and the tools described. Ha (12l)

Improved Quality and Reduction of Costs in Polishing. (Gütesteigerung und Kostensenkung beim Schleifen.) KUNG. *Maschinenbau,* Vol. 10, Feb. 19, 1931, pages 111-113.

The basic questions in the discussion of polishing are worked out. Several instances are given where provision is being made for calculated data. MAB (12l)

Experiments in Metal Polishing. EDWIN M. BAKER & GEORGE E. HOLBROOK. *American Machinist,* Vol. 74, May 14, 1931, pages 749-751.

Condensed from a paper before the Electrochemical Society, Birmingham, Ala., Apr. 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 21. RHP (12l)

Cleanliness of Polishing Abrasives. H. R. POWER. *Metal Cleaning & Finishing,* Vol. 3, Jan. 1931, pages 43-44.

The author notes that the presence of oily dust in abrasive grains lowers their efficiency. The abrasive dust formed by attrition, however, does not have any ill effects. The tests are described. Ha (12l)

Burnishing with Tungsten Carbide. F. J. SANDERS. *Machinery,* Vol. 37, May 1931, pages 674-676.

Description of a machine in which cams are burnished accurately to size. Production costs could be reduced 80%. Ha (12l)

Comparison of Two Grinding Machines. (Vergleich zweier Schleifmaschinen.) E. SACHSENBERG. *Maschinenbau,* Vol. 10, Jan. 1, 1931, pages 12-14.

Two kinds of handles for a hand-grinding machine are compared for their economic values and for their suitability for the operator. Tests are made. MAB (12l)

Double-wheel Grinding Method for Cast-iron and Hard-alloy Cylinder Liners. *Abrasive Industry,* Vol. 12, Sept. 1931, pages 36-37.

The introduction of centrifugally cast and hard-alloy liners for bores of automotive engine cylinders brought new problems in the finishing of the outer surfaces. It is essential for the liner to make a metal-to-metal contact with the bore of the cylinder. Grinding has proved to be the most satisfactory method, but difficulty has been experienced in the holding of the work and the prevention of distortion during grinding. The expanding arbor fitted to the special machine has proved successful in grinding this work because the adjustment is sensitive and eliminates the possibility of distortion. WAT (12l)

Controlled Structure of Grinding Wheels Means Better Grinding. *Grits & Grinds,* Vol. 22, June 1931, pages 11-12.

The Norton Co. manufactures their grinding wheels under strict control of the abrasive grain, the bonding material for holding the grains together and, also, the pores formed by the grain and bond. In this manner an absolutely uniform product of any desired structure can be obtained. Ha (12l)

Coloring (12m)

Black Coloring of Wire Products, a Description of German Low Cost Processes. *Wire & Wire Products,* Vol. 6, June 1931, pages 228-229, 250.

The black coloring of nails, hair pins, safety pins, wire eyes, wire clips and other products is intended partly to cover the shiny metal and partly to increase the durability of the article. Nails are usually burnt in oil or fat; for pins and needles, a purely chemical coloring in a solution of 10 g. of sulphate of copper, 15 g. stannous chloride, 20 g. hydrochloric acid in 1 liter of distilled water is employed. Small iron ware is colored in the diamond black oxide process; they are dipped for a short time in a hot coloring bath to obtain a deep black matt coloring. The polish is obtained by placing the articles in sawdust moistened with oil and rotated in a drum. Some other processes, using lyes or sulphur, are described. Mass articles are often colored black by lacquering; spirit as well as soap lacquers may be used. Fat lacquers are particularly durable. Methods of spraying and drying are described in detail. Ha. (12m)

Sandblasting (12n)

Overloading Reduces Efficiency in Sandblast Barrel Machines. LOUIS D. PEIK. *Foundry,* Vol. 59, Sept. 15, 1931, pages 53, 55.

Results of a series of tests indicated that the following causes influence cleaning production: (1) depth of loading, (2) capacity of barrel, (3) angle of blast, (4) speed of barrel and (5) mixture and class of work. VSP (12n)

Progress made in the Removal of the Crust of Cast Steel (Progres réalisés dons le décapage de l'acier coulé). A. SISSON-LEHMANN. *L'Usine,* Vol. 40, July 31, 1931, page 33; *Revue Fonderie Moderne,* Vol. 25, Aug. 25, 1931, pages 314-316.

Sand blasting for cleaning cast steel pieces of the hard skin due to vitrified molding sand is still a fairly neglected and very expensive item of a steel foundry. In 2 French steel foundries, good results have been obtained by the replacement of sand in the sand blast by steel grit. The advantages claimed are diminution of cost of transportation, purchasing and storing of the special sand for blasting purposes which must also be dried and sifted. Steel grit can be had easily in the steel work; it is powdered when blown on to the casting; its effect is, however, less rapid than that of sand. For each ton of steel cleaned, about 2-4 kg. of steel grains were used. The economical advantages are discussed in much detail. Ha. (12n)

The Advantages of Steel Grit and Shot for Sand-Blasting Work. G. H. ZIRKER. *Engineering Progress,* Vol. 12, Apr. 1931, pages 92-94.

In using a Si-Mn steel grit for sand blasting operations, removing rust and grease, several advantages over quartz sand are obtained. The life of steel as grit is about 60 times that of sand, which means that considerably less expense for storing, transporting and drying is involved. The high resistance to wear results in nearly dustless operation, so that the disagreeable dust removal is reduced considerably. Air consumption is from 10 to 40% lower. The most effective pressure was found to be from 1 to 3 atmospheres for finer grades and between 3 and 6 atmospheres for the coarse grades, whereas quartz sand requires between 0.5 and 3 atmospheres. Several examples were cited where operation with steel grit led to improvement and economies. Ha. (12n)

DEFECTS (13)

A Suggested Method of Determining the Cleanness of a Heat of Steel. Samuel Epstein (Battelle Memorial Institute). *Metals & Alloys*, Vol. 2, Oct. 1931, pages 186-191.

The author points out that chemical methods are supplanting microscopic means of determining the cleanness of steel. This he attributes to the failure of the metallographer to realize the importance of sampling. 2 classes of inclusions exist: small, fairly uniformly distributed inclusions and segregations or large inclusions occuring at random. 3 methods appearing recently in the literature are reviewed. The proposed method developed at the South Chicago plant of Illinois Steel Co. has as its first consideration adequate sampling. Systematic sampling from stated portions of ingots and uniform reduction and size of specimens is followed. The results of such a method are described. The technique of polishing for study of inclusions is important. WLC (13)

Research on Wrought-Iron Chains. The Nature of Defective Lamination in Wrought-Iron Bars and Chain Links. H. J. Gough & A. J. Murphy. *Iron & Coal Trades Review*, Vol. 122, May 8, 1931, pages 731-736; *Engineering*, Vol. 151, May 22, 1931, page 566.

The fractured surface of a bar or chain link sometimes reveals the presence of one or more laminations exhibiting a brittle, coarsely crystalline appearance, the remainder of the section having the normal appearance of ductile wrought iron. This phenomenon was investigated; test methods, preparation of specimens are described and graphical results given. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 273. Ha & LFM (13)

Elimination of Transverse Fissures in Steel Rails. *Iron & Steel of Canada*, Vol. 14, Aug. 1931, pages 127-128.

Reference is made to a process which has been perfected by I. C. Mackie of the Dominion Iron & Steel Company for preventing the formation of transverse fissures in steel rails. The invention relates to the discovery of the precise stage in the production of rails when too rapid cooling results in "shatter cracks." OWE (13)

Corrosion and Radiator Solder Seam Failure. W. H. Wilson. *Automotive Industries*, Vol. 65, July 18, 1931, pages 84-87.

Some years ago there was much talk, particularly in the field, about the corrosive effects of anti-freezes in general on the metals of the cooling system. Little definite knowledge was at hand concerning the action of water, heat, aeration, anti-freeze on solder, copper, iron, brass, aluminum and rubber—the materials most commonly used in cooling systems. The processes of radiator clogging and radiator disintegration had not been intensively studied. All these subjects have been under investigation. The conclusions can be summarized as follows: 1. The solder used in the manufacture of the five most commonly used makes of cellular radiators has considerable resistance to corrosion. Road shock and vibration are evidently necessary to produce the type of solder failure usually found in automobile radiators in the field. 2. Water can have a very severe corrosive action on brass radiators. Anti-freeze solutions caused no apparent corrosion of brass, whereas ordinary water corroded brass water passages sufficiently to cause the appearance of many leaks in the form of small, round holes, or weak spots down the center of the ribbon. (13)

CHEMICAL ANALYSIS (14)

Rapid Method for the Determination of Vanadium in Ferro-Vanadium (Schnellverfahren zur Bestimmung des Vanadins in Ferrovanadin). A. Eder. *Stahl und Eisen*, Vol. 51, Oct. 1, 1931, pages 1236-1237.

The described American titration method for V offers the disadvantage that at room temperature V_2O_4, towards the end of the titration with permanganate, has too low a velocity of oxidation so that the end of the titration cannot be determined accurately. This disadvantage cannot be eliminated by titrating with an excessive amount of permanganate and re-titrating the excess of permanganate with arsenic acid. This new titration method is described in detail and illustrated by an example. GN (14)

Application of the Spectrograph to the Analysis of Non-Ferrous Metals and Alloys. H. W. Brownsdon & E. H. S. van Someren. *Engineer*, Vol. 152, Oct. 2, 1931, pages 359.

Abstract of a paper read before the Institute of Metals, Zurich, Switzerland, Sept. 15, 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 274. LFM (14)

The Detection of Foreign Elements in a Metal by Spectral Analysis (Sur la recherche par l'analyse spectrale des éléments étrangers dans un métal). Lucien Amy. *L'Industrie Électrique*, Vol. 40, Jan. 10, 1931, pages 20-21; *Comptes Rendus*, Vol. 191, Dec. 1, 1930, pages 1049-1050.

Description of a very sensitive method which consists in photographing 2 spark spectra side by side. The one is between 2 pieces of the metal to be investigated and the other between 2 pieces of the pure metal. The procedure and the precautions to be observed are described in detail. Ha (14)

Fundamentals of Chemical Analysis as Applied to Electroplating. L. C. Pan. *Metal Cleaning & Finishing*, Vol. 3, Jan. 1931, pages 37-40; Feb. 1931, pages 129-132.

Methods and apparatus for controlling the composition of plating baths, reading analysis charts and making up standard reagents are described. The gravimetric and volumetric methods are explained. Ha (14)

The Determination of Nickel and Chromium in Metal Alloys and Cast Iron. (Die Bestimmung von Nickel und Chrom in Metallegierungen und Gusseisen.) V. Pestelli. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 13, 1931, page 883.

The existing methods are reviewed and new ones discussed to permit a greater accuracy. No definite conclusions as to the best methods have been arrived at. Ha (14)

ECONOMIC (16)

The Significance of Specifications in Purchasing Steel. P. Parke (The Pullman Co.). *Railway Age*, Vol. 91, Dec. 5, 1931, pages 867-868.

Material specifications are of particularly economic importance to the large steel user in that: (1) They are evidences of the fact that thought and study have been given to the severe requirements for which a particular material is intended. (2) They constitute a standard for measuring and checking materials as supplied. Such checking insures against delay and waste in fabrication which would occur with improper materials. (3) They are invaluable to the large consumer who commonly draws his material from several sources of supply. Their proper application, in such cases, insures that materials from different sources will be of uniform and suitable quality. (4) They promote the highest and best use of materials for each particular purpose. (5) They open a field of fair competition. WAT (16)

Production Economy in Iron and Steel Works. Otto Cromberg. *Iron & Steel of Canada*, Vol. 14, May 1931, pages 77-80, 91; abstracted in *Engineer*, Vol. 151, May 15, 1931, pages 534-535.

Paper read before the Iron & Steel Institute May 7-8, 1931. Only the first part is given in this issue of Iron & Steel of Canada. It includes a discussion of a fundamental study of the laws of factory management which has been carried out in Germany since the war. The article is accompanied by 5 tables and an output diagram. The tables show the results of time studies with various machines and men; the curves show the improvement in production resulting from strict supervision of contract outputs and of repair work. See also *Metals & Alloys*, Vol. 2, Nov. 1931, page 276. OWE (16)

Reorganization of the Iron and Steel Industry. *Engineer*, Vol. 151, May 8, 1931, page 508.

Short note commenting on memorandum issued by the National Federation of Iron & Steel Manufacturers. Cites instances of the effort being made to improve conditions in the iron and steel industry both in Great Britain and in the Dominions. Gives names of some of the companies which have combined forces to take advantage of large scale production methods. LFM (16)

The Metal Industries in the North. Trade Conditions in the West of Scotland. *Metal Industry*, London, Vol. 38, May 1, 1931, pages 449-451.

Not only has the world wide depression affected the ferrous and non-ferrous industries, but also have the decline of export trade, curtailment of Admiralty work, lack of expansion in the home markets, and heavy local taxation. PRK (16)

Steel for Tinplate. *Tin*, Sept. 1931, pages 3-6.

An economic investigation of the Welsh tinplate industry which is said at present to be unable to compete with tinplate from other countries on account of the manner of making the steel by the basic Bessemer process instead of by the open-hearth system as in other countries. A possible remedy is seen in the duplex process. Ha (16)

Reduction and Refining of Lead in 1930. *Mining & Metallurgy*, Vol. 12, Jan. 1931, pages 7-8.

Review of the progress, especially in the new Australian plants. Ha (16)

The Continental Steel Cartel. *Engineering*, Vol. 131, Jan. 23, 1931, pages 114-115.

Editorial commenting on recent decision of the Continental Steel Cartel to reduce the total quota. This is an attempt to assist the recovery of the Continental steel industry from the present decline. For the first quarter of 1931, a reduction of 30% will be made in the quota. LFM (16)

Steel, Confident Recovery Near, Girds for Tenser Rivalry. E. C. Barringer. *Steel*, Vol. 88, Jan. 1, 1931, pages 241-244, 254.

The 10 largest producers of steel have spent the year 1930 in strengthening their competitive positions with many new subsidiary relationships involving merger or purchase. The Bethlehem Steel Corp. has expanded considerably, extending its influence westward by absorbing Cambria and Lackawanna, and by attempting to merge with the Youngstown Sheet and Tube Co. The U. S. Steel Corp. has built 21 new open-hearth furnaces and greatly improved its facilities in the Chicago, Pittsburgh, Lorain and Cleveland Districts. The greatest competition between U. S. and Bethlehem promises to be in the field of structural steel with welded steel pipe a likely close second. JN (16)

Gold and Silver in 1929. J. P. Dunlop. *Mineral Resources of the United States, 1929, United States Bureau of Mines*, Oct. 1931, pages 877-920. Part 1.

Gold production in the U. S. in 1929 was 2,208,386 oz., worth $45,651,400, a decrease of 514,000 oz. from 1928. Silver production was 61,327,868 oz., worth $32,687,754, an increase of 2,865,361 oz. and a decrease of $1,512,813 in value. Arts and manufactures used 54.5% of the domestic output of new Au and 50.4% of the Ag. Figures for world production are given. AHE (16)

Economic Significance of Special Alloy Steels. H. Batcheller. *Mining & Metallurgy*, Vol. 12, July 1931, pages 312-318.

An economic discussion of the steel industry in general, methods of merchandizing, suggestions for improving conditions, research work and alloyed steels and treating processes for refining and future possibilities. Ha (16)

Building Industry Attains Leadership in 1930 as Consumer of Finished Rolled Steel. *Steel*, Vol. 88, Jan. 1, 1931, pages 248-251.

Gives short discussion of steel demand in 1930 with series of charts and tables showing percentages of annual steel output utilized by the 5 main groups of consumers; building industry, railroads, automotive industry, oil, gas and water industries, and exports for the years 1922 to 1930. A table of steel ingot production shows the tonnages consumed by each of the above groups. Two comprehensive tables give the percentages and the actual gross tons of each type of finished steel product consumed by each group of users. JN (16)

Society for Electrochemical Industry of Norway. (Det Norske A/S for Electrokemisk Industri). *Journal du Four Electrique*, Vol. 40, June 1931, pages 212-214.
This company occupies the predominant position among Norwegian organizations covering the whole field of activities from ore prospecting to the manufacture of chemicals. Just recently the company developed a satisfactory process for production of steel directly from ores in an electric furnace. JDG (16)

Ferro-alloy Trade in France in 1930 (Le marché francais des ferroalliages en 1930). *Journal du Four Electrique*, Vol. 40, Feb. 1931, pages 49-50.
A brief survey of the amounts of ferro alloy consumed in 1930 and the price variations of Fe-Si, Si-Mn, Fe-Mn and ferro-chromes. JDG (16)

Per Capita Steel Use Declines; United States Still Leads. *Steel*, Vol. 88, Jan. 1, 1931, page 270.
The consumption of steel in the U. S. in 1930 was 731 lbs. per capita, a decrease of 27% from 1929. In Belgium-Luxemburg, it was 581 lbs., a decrease of 38%. England consumed 356 lbs. per capita, a loss of 39%; and Germany used 301 lbs., a decrease of 31%. France, however, lost but 1 lb. per capita, using 298 lbs. per capita in 1930 as against 299 lbs. in 1929. JN (16)

Platinum is Surprisingly Cheap. *Journal Society Chemical Industry*, Japan, Vol. 34, June 1931, page 181B.
The price of Pt which recently broke to the level of 7 yen momme (3.75 g.) has collapsed again to a point as low as 6.50 yen, or only 1/10 of 64 yen/momme in 1918. Japan is importing about 11 kg. of Pt/mo. ½ of which is used for technical purposes, the other half for ornaments. MAB (16)

Uniform Cost Methods for Steel and Alloy Foundries. *Steel Founder*, Vol. 2, Apr. 1931, pages 12-13.
The Steel Founders Society of America has worked out a uniform cost sheet which it advocates for general use. Ha. (16)

New Worlds for Steel to Conquer. *Steel*, Vol. 88, Jan. 1, 1931, pages 245-247.
New ideas in architecture show a tendency for exposing the steel framework of buildings. This is seen in a few hospital and church structures in Europe and, to its fullest extent, in the new building of the Worcester Pressed Steel Co. A new building of the A. O. Smith Corp. uses steel plate floors, movable steel partitions, steel wall columns, steel grid flooring and steel plate floor base. The development of steel frame homes of moderate cost, with interior furnishings, sashes, ventilating panels and kitchen and bathroom fittings all of steel, offers a future market for steel products. The use of steel for farm buildings will also create a demand. A large future outlet for steel appears to be in the construction of pipe lines of electrically welded pipe for oil, natural gas, gasoline and, possibly, powdered coal. Much steel will be required, also, for constructing elevated thoroughfares for motor traffic in congested city districts. JN (16)

Steel Plant Expansion Continues Despite Reduction in Earnings. *Steel*, Vol. 88 Jan. 1, 1931, pages 295-297.
In spite of the depression, many millions of dollars were expended in 1930 for steel plant and rolling mill expansion. This is seen in the construction of by-product coke ovens, basic open hearth furnaces, Bessemer converters, rolling mills for producing large diameter electric welded pipe, and plate strip mills. Stacks, blast-furnaces, hot blast stoves and regenerative furnaces were redesigned and enlarged. Improvements were made in sintering plants, in the molding and cooling of pig-iron, in the wider use of natural gas, and in the installation of large type turbo-blowers and combustion control equipment. JN (16)

Production of Iron and Steel in Canada, June, 1931. *Iron & Steel of Canada*, Vol. 14, July, 1931, page 113.
A statement of the production of pig iron, ferro-alloys, steel ingots and castings, and prices in Canada during June 1931. OWE (16)

Production of Iron and Steel in Canada, May, 1931. *Iron & Steel of Canada*, Vol. 14, June 1931, page 97.
A statement of the production of pig iron, ferro-alloys, steel ingots and castings, and prices in Canada during May 1931. OWE (16)

The United States Iron Industry in 1930. *Iron & Steel of Canada*, Vol. 14, May, 1931, page 86.
Abstracts from publications of the U. S. Bureau of Mines, Department of Commerce, covering the year 1930 in the iron and steel industry of the United States.

Production of Iron and Steel in Canada, April, 1931. *Iron & Steel of Canada*, Vol. 14, May, 1931, page 83.
A statement of the production of pig iron, ferro-alloys, steel ingots, and castings, and prices in Canada during Apr. 1931. OWE (16)

General Contraction in World Production of Iron & Steel for 1930. *Iron & Steel of Canada*, Vol. 14, Mar. 1931, page 50.
A brief article accompanied by tables giving details of the decline in world production of iron and steel during 1930 and referring particularly to the variation in production in Great Britain and to the effect upon the market of the East Indian tariff on galvanized sheet. OWE (16)

World Steel Production in Spectacular Drop. *Steel*, Vol. 88, Jan. 1, 1931, pages 266-267.
The year 1930 saw a tremendous drop in the world's iron and steel production. Steel output decreased 19% and pig iron 17.4%. In Germany, steel production fell off 27.5%; in Great Britain 21.2%; in Belgium. 17%; while in France, steel production decreased only 3.4%. The U. S. production fell off from 47.25% of the world's total to 44%. Tables are given showing the production of steel and pig iron in each country from 1913 to 1930. JN (16)

Present Position of the Iron and Steel Industry, *Engineer*, Vol. 151, May 29, 1931, page 606.
From memorandum issued by the National Federation of Iron and Steel Manufacturers. Comments on measures recommended for improving the iron and steel industry such as relief from excessive taxation, protection of the home market, stabilization of world prices and market conditions, and the use of tariffs for obtaining entry to markets now barred by tariffs. LFM (16)

PLANTS & LABORATORIES (17)

Christiania Steel and Rolling Mills (Christiana Spigerwerk Staal og Valseverker). *Journal du Four Electrique*, Vol. 40, June 1931, pages 236-237.
The present works, with the capacity of 40,000 tons per annum, were the results of absorption of the smaller concerns by the original organization founded in 1853. Beside the usual steel mill equipment, it has a 6000 kwh. furnace for direct production of steel from ore which was installed in 1922-1925 and solves the problem economically. Its subsidiary, Norsk Valsewerk at Bergen, produces almost the total requirement of Norway for tin plate. JDG (17)

A New Copper and Brass Rolling Mill in India. *Metal Industry*, London, Vol. 38, May 15, 1931, pages 497-498.
A description of a rolling mill with a capacity of 50 tons of Cu/wk., erected by the Krupp Works. PRK (17)

Norwegian Zinc Company, Ltd. (Det Norske Zinkkompani A/S). *Journal du Four Electrique*, Vol. 40, June 1931, pages 230-231.
The largest European electrolytic zinc plant with the capacity of 40,000 tons a year uses Anaconda type installation. General description is given. JDG (17)

Metallurgical Investigations at Bell Laboratories. *Metal Progress*, Vol. 19, May 1931, pages 33-38.
Notes on the problems and equipment in use at the Bell Laboratories for Metallurgical Investigations. WLC (17)

Steel Plant Built at the Door of a Great Market. *Iron Age*, Vol. 126, Nov. 27, 1930, pages 1606-1610, 1665.
Describes the plant of the Great Lakes Steel Corporation with an annual capacity of over 500,000 tons. Its products will consist of billets, sheet bars, forging bars, strip steel, automobile spring steel, rim sections, bumper steel, window-sash sections, concrete bars and small angles and channels. Approximate cost is about $25,000,000. Plant units are laid out for straight-line production. Future extensions can be made with minimum interference with operations. VSP (17)

Norwegian Nitrides Corporation (Det Norske Nitridaktieselskap). *Journal du Four Electrique*, Vol. 40, June 1931, pages 224-226.
Though originally intended for manufacture of nitrides, the plants of the company never manufactured them. Metallic Al is the only product. 2 plants at Eydehavn and Tyssedal are in operation at the present, under control of British and American Aluminum Companies and Compagnie des Produits Chimiques d'Alais. JDG (17)

The Sand-Spun Pipe Foundry of the Staveley Coal and Iron Company, Limited. *Foundry Trade Journal*, Vol. 45, July 30, 1931, pages 71-73; Aug. 6 1931, pages 83-85.
A detailed description of the sand-spun pipe foundry of the second largest manufacturer of cast iron pipes in the United Kingdom. This factory is designed for an annual output of 80,000 long tons of pipes from 4 in. to 12 in., inclusive, nominal diameters, of 16-foot laying length. The article is accompanied by 12 photographs and 1 diagram, showing the general lay-out of the plant. The Company holds the sole patent rights for Great Britain from the Sand-Spun Corporation. OWE (17)

Meeting Steel Mill Problems at Canadian Plants. *Canadian Chemistry & Metallurgy*, Vol. 15, July 1931, pages 195-197.
Special reference to specifications and the plant of the Algoma Steel Corp. at Sault Ste. Marie, Ontario, seems to reflect the Canadian industry as a whole. WHL (17)

Spring Production for Railway Rolling Stock. *Metallurgia*, Vol. 3, Apr. 1931, pages 199-203.
Describes equipment and methods used by Great Western Railway Co. in manufacturing both laminated and coiled springs. C steels are used for both types. JLG (17)

Expected Activity of New Aeronautical Laboratory. *Journal Society Chemical Industry*, Japan, Vol. 34, June 1931, pages 179-180B.
Reviews what is supposed to be the world's most perfect laboratory of its kind, the Aeronautical Research Institute of Tokyo Imperial University at Komaba, officially opened May 11, 1931. It has space for specialized research in aeronautical physics, chemistry, metallurgy, material, motor, and psychology for aviator. It has a large wind tunnel, a library and central workshop. MAB (17)

The Aluminum Alloy Rolling Mills at Chippis. *Journal Institute of Metals*, Vol. 47, June, 1931, page 5.
Slabs of 100-1000 kg. in weight are rolled down on a 3-high mill with 700/250/700 x 1700 mm. rolls. They then go through a 3-high hot mill of 900/450/900 x 3300 mm. for the production of heavy structural plates or through a 3-high strip mill for sheets of smaller sizes up to 1m. wide. All furnaces are electrically operated with one exception and consume 1500 kw. Other equipment is briefly mentioned. Ha. (17)

Pressed Steel Sleeper Plant at the Glengarnock Works of Colvilles, Ltd. *Iron & Coal Trades Review*, Vol. 123, Nov. 20, 1931, pages 785-787.
A full description of the plant for making railroad ties from bar to finished product. The presses develop 220 tons each. The sleeper-bar heating furnace has a normal output of 15-20 tons of bars/hr. Ha. (17)

Gary Mill Designed for 25,000 Tons a Month of 26-In Strip. *Iron Age*. Vol. 126, Aug. 21, 1930, pages 488-490.
Describes the 28-in. strip mill of the Illinois Steel Co. at Gary, Ind. Mill which comprises 7 two-high stands of rolls 24 in. in diameter, 6 two-high stands of 28-in. rolls and 2 sets of vertical edging rolls, all of which are motor driven. Produces strip steel up to 26 in. in width at rate of 25,000 tons/month. VSP (17)

Stavanger Electric Steel Company (Stavanger electrostaalverk A S). *Journal du Four Electrique*, Vol. 40, June 1931, pages 218-219.
This plant organized in 1910 possesses a completely equipped steel works with the annual capacity of 6000 tons of common alloy and stainless steels. An exceptional quality of the finished product can be obtained here because the original ores which are worked by a duplex process contain 0.06% V and 2% Ti beneficially affecting the quality of steel. JDG (17)

Heat-Treating Pipe Couplings to Withstand High Pressures. *Fuels & Furnaces,* Vol. 9, Jan., 1931, pages 55-58.

The plant equipment for heating, reheating, temperature control and the burner equipment of the Dresser Manufacturing Co., Bradford, Pa., is described and illustrated. Ha. (17)

The Laboratories of the Iron and Foundry Institute of the Academy of Mines Clausthal (Die Laboratoriumsanlagen des Instituts für Eisenhütten—und Giessereiwesen der Bergakademie Clausthal). *Giesserei mit Giesserei-Zeitung,* Vol. 18, Oct. 30, 1931, pages 848-850.

A description of the melting and pouring rooms, the equipment of the metallurgical, heat and materials testing laboratories. The practical work of students is described. Ha. (17)

Increases Production with Handling Equipment. *Foundry,* Vol. 59, Oct. 15, 1931, pages 40-41.

The layout and equipment of the foundry of the American Seating Co., Grand Rapids, Mich., is described. Ha. (17)

Non-Ferrous Metals Research. *Electrical Review,* Vol. 108, June 12, 1931, pages 994.

Description of new administrative buildings and central research and development laboratories in London. Ha (17)

Heat Treating Equipment in a Modernized Plant. *American Machinist,* Vol. 75, Oct. 22, 1931, pages 635-637.

Description of the plant of R. Hoe & Co. Ha. (17)

Specializes in Stoves for Seventy-Six Years. PAT DWYER. *Foundry,* Vol. 59, Sept. 15, 1931, pages 26-28, 40.

Describes the plant of the Pratt Manufacturing Co., Watertown, Mass., established in 1855. VSP (17)

Electrification of Merchant Mills. E. J. POOLE & O. C. CALLOW. *Freyn Design,* No. 9, Oct., 1931, pages 1-4.

A description of a recently electrified 16 in. guide mill, a 12 in. bar mill, a 10 in. guide mill and a 10 in. bar mill of the Carpenter Steel Co. in Reading, Pa. Ha (17)

Tool Heat Treating at Schenectady. R. H. MITCHELL. *American Machinist,* Vol. 75, July 23, 1931, page 163.

Brief description of the layout of the plant and arrangement of equipment. Ha. (17)

The Newport News Shipyard; How Welding is Revolutionizing Ship Construction. JAMES W. OWENS. *Welding,* Vol. 2, Nov. 1931, pages 734-736.

Notes the great extent to which welding is now used. Ha. (17)

The Development of the Herminenhütte in Laband, Upper Silesia, with Special Reference to the New Constructions and Reconstructions After the Year 1926 (Die Entwicklung der Herminenhütte in Laband, O.-S., unter besonderer Berücksichtigung der Neu- und Umbauten nach dem Jahre 1926). C. NETTER. *Stahl und Eisen,* Vol. 51, October 22, 1931, pages 1306-1313.

Report 89 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Whereas a previous paper dealt with a description of this Upper Silesian steel plant before the modernization (see *Stahl und Eisen,* Vol. 51, Sept. 24, pages 1189-1192) the present paper gives a detailed account of the changes that have been effected by the reconstruction of the rolling mills since the year 1926. After dealing with the reasons for the modernization, the new rolling mills are individually described. The production capacity could be increased from 6800 tons of hoops and bars to a monthly production of 3000 tons of hoops and 9000 tons of bars with 2 shifts/day. The production of the mill is not large in comparison with the large mills in Western Germany, but it is nevertheless remarkable due to the large number of various shapes which are rolled during a shift. GN (17)

Melts Bronze in Crucibles. FRANK MCKLVEEN & R. H. STONE. *Foundry,* Vol. 59, Sept. 15, 1931, pages 38-40.

Describes operation of the Robertshaw Thermostat Co., Youngwood, Pa. The company produces castings in 85-5-5-5 metal and, as castings are Cr plated, the requirements are severe. The melting equipment consists of 5 tilting type furnaces made by Campbell-Hausfield Co., each taking a standard No. 125 Steel-Harvey graphite crucible. Unusual economies in fuel consumption have been achieved. Outlines daily practice. Lining of combustion chamber is rammed in place using a silicon-carbide refractory. Cost of melting can be taken either as ready to pour out of the furnace or cost of metal delivered to the molds. VSP (17)

Indirect Heat Utilized in Dual Purpose Oven. J. B. NEALEY. *Foundry,* Vol. 59, May 1, 1931, pages 70-71.

Describes the oven installation at the plant of Hansell-Elcock Co., Chicago, which produces castings ranging from a few oz. to 30 tons. VSP (17)

Facilitates Production of Large Steel Castings. E. C. KREUTZBERG. *Foundry,* Vol. 59, May 1, 1931, pages 44-49; *Steel,* Vol. 88, May 14, 1931, pages 35-37, 52.

Describes the new plant of the General Steel Castings Corporation, Eddystone, Pa. Castings for locomotives and railroad cars are to be the chief products. The present capacity of the plant is between 6000 and 7000 tons of castings/mo. Steel is melted in 3 50-ton open hearth furnaces. Patterns and core boxes are handled collectively. Continuous core oven 230 ft. long is arranged in 5 tiers. It is heated by 4 oil fuel units. Ha+VSP (17)

The New Montreal Foundry of the Canadian National Railway Company. *Foundry Trade Journal,* Vol. 45, Aug. 13, 1931, pages 99-101; *Canadian Foundryman,* Vol. 22, May, 1931, pages 7-11.

A description of the gray iron foundry at the Point St. Charles (Montreal) shops of the C.N.R., which is the fourth unit to be completed under a rehabilitation and modernization program. The article is accompanied by 10 photographs. OWE (17)

Electrical Equipment for Gulf States Steel Universal Plate Mill. R. H. WRIGHT. *Blast Furnace & Steel Plant,* Vol. 18, Nov. 1930, pages 1710-1711.

A direct current reversing motor of 4000 h.p. and 80/160 r.p.m., 80 volts drives the 32 in. 3-high universal mill; it is supplied by 3200 kw. fly-wheel motor-generator set. The electrical installation for the auxiliaries is described in detail. Ha. (17)

MISCELLANEOUS (20)

Wire Cable Compacted by Stretching it Beyond Working Load. *Iron Age,* Vol. 125, June 12, 1930, pages 1748-1749.

In order to equalize irregularities and ununiformities of manufacture in wire cables, they are pre-stressed beyond the working load. The method of doing this in the works of J. A. Roebling is described in detail and examples of a few bridges where the suspension cables were treated in this manner are given. Ha. (20)

Calculation and Administration of Spare Parts in Steel Mills (Verrechnung und Verwaltung von Ersatzteilen auf Hüttenwerken). *Archiv für Eisenhüttenwesen,* Vol. 5, Aug. 1931, pages 127-128.

Report 51 of the Committee on Plant Efficiency of the Verein deutscher Eisenhüttenleute. Brief résumé and discussion of papers on the above subject at a meeting of the mentioned committee. GN (20)

Intermediary Compounds Formed during the Catalytic Synthesis of Ammonia. Detection of a "Surface Nitride" Consisting of Tungsten and Nitrogen (Zur Kenntnis der Zwischenverbindungen bei der katalytischen Ammoniaksynthese. Auffindung der Bildung eines "Oberflächen-Nitrids" aus Wolfram und Stickstoff). G. MESSNER & W. FRANKENBURGER (I. G. Farbenindustrie). Zeitschrift für physikalische Chemie, Bodenstein Festband, 1931, pages 593-607.

The heterogeneous systems (1) W-NH_3, (2) W-H_2, (3) W-N_2 and (4) $W(N)_x$-H_2 are investigated and effects observed indicating 2 modes of union of gases at the metallic surface, i.e., in the case of (1) and (2) and absorptive and in the systems (3) and (4) a chemical binding. Conclusions drawn are (a) NH_3 and H_2 are normally absorbed by pure W powder; (b) a phenomenon never identified before (the molecular binding of N by metallic W) was detected and proved to be a chemical reaction by the determination of the temperature dependence, course of velocity and non-reversibility; (c) the nitride discussed slowly absorbs H between 20° and 200° C. and probably forms a hydrogenation product with the N_2 previously absorbed; (d) the reactions given under (b) and (c) are considered as partial processes closely connected with the catalytic synthesis of NH_3 with W as a catalyser. EF (20)

Training Apprentice to Foreman. E. H. BALLARD. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 2, Jan. 1931, pages 767-770.

The author feels that training is more necessary than ever in the foundry, because of keener competition which requires a higher standard to put the foundry on a plane equal to that of other manufacturing departments. CHL (20)

Binary Catalysers on Molybdenum-Base Applied for the Ammonia Synthesis (Ueber binäre Molybdän-Mischkatalysatoren bei der Ammoniaksynthese). A. MITTASCH & E. KEUNECKE (Research Laboratory I. G. Farbinindustrue, Oppau). *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 574-582.

The system Co-Mo and Fe-Mo, as well as mixtures of Mo with Cu, Cr, W and Mn, were investigated as catalysers with reference to the ammonia synthesis. An increase in efficiency could be secured if the components form compounds. This is also true for the systems Ni-Mo, Co-Mo, Fe-Mo, Mn-Mo. The combination Cu-Mo acts merely additively, since the components are indifferent. Formation of solid solutions weakened the catalytic effect of the binary systems W-Mo and Cr-Mo, which do not enter a chemical compound. The formation of a chemical compound does not, however, necessarily result in an activation, as was revealed with the system Mo-S, which disclosed a remarkable, poisonous effect. EF (20)

Cupola Slag is Granulated. M. J. GREGORY. *Foundry,* Vol. 59, June 1, 1931, page 75.

Slag running out against a stream of water over a tank is broken up into pieces of about ¼ in. mesh. Ha. (20)

The Photo-Electric (Bequerel) Effect on Electrodes of Bismuth Oxide (Die Gesetzmässigkeiten des lichtelektrolytischen Effekts (Bequerel-Effekts) an Wismutoxydelektroden). A. COEHN & R. MYKOLAJEWICZ (University of Göttingen). *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 641-655.

Only electrodeposited Bi_2O_4 shows the Bequerel-effect among a large number of metal oxides. The photo-electric reduction of Bi_2O_4 to Bi_2O_3 accounts for the change in electrode potential when the electrode is radiated. A local element between the Bi_2O_4-Bi_2O_3 mixture and the carrier metal exerts an influence, too. Bi_2O_4 is furthermore reduced to Bi_2O_3 due to the light energy absorbed. The oxygen liberated diffuses to the surface where O_2 changes the potential. The quantum yield, however, is of a very small order: 10^{-5}-10^{-4} electric elementary charges per light-quantum. EF (20)

Directions for the Design of Proper Water Chambers for Acetylene High Pressure Apparatus (Richtlinien für den Bau geeigneter Wasservorlagen für Azetylen-Hochdruckapparate). H. FRIEDRICH. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylene,* Series 6, 1931, pages 65-80.

The German rules for acetylene operations require a safety device, usually a water chamber in front of the acetylene developer which acts as protection against back firing of the flame and against the possibility of O entering the acetylene pipes. The different methods and the testing of their efficiency are discussed, described and illustrated. See also *Metals & Alloys,* Vol. 2, Oct. 1931, page 227. Ha. (20)

A New Profile for Spring Plates (Ein neues Federblattprofil). *Krupp'sche Monatshefte,* Vol. 12, Jan. 1931, pages 7-9.

A new profile for spring plates which marks a remarkable progress in the making of springs is described. The new shape offers the advantage of making softer and more durable springs. GN (20)

FOUNDRY PRACTICE & APPLIANCES (22)

Meeting the Demand for Aluminum Castings. *Canadian Foundryman,* Vol. 22, Aug. 1931, pages 7-11.

The characteristics and applications of a number of Al alloys are described and details given of pattern and core design, suitable molding sands and gating requirements in the production of castings from these mixtures. Reference is made to "modification" and heat-treatment processes and to methods of inspection. OWE (22)

Centering Ingot Mold Cores. *Foundry,* Vol. 59, Jan. 1, 1931, page 74.

Description of several methods of centering ingot mold cores as well as the practice in some foundries. Ha (22)

Prevent Losses with Proper Gates and Risers. PAT DWYER. *Foundry,* Vol. 59, Jan. 1, 1931, pages 56-60; Jan. 15, 1931, pages 48-51; Feb. 1, 1931, pages 66-68; Feb. 15, 1931, pages 49-51; Mar. 1, 1931, pages 66-69; Apr. 1, 1931, pages 57-59; May 1, 1931, pages 52-54; June 1, 1931, pages 60-62; June 15, 1931, pages 41-43; July 1, 1931, pages 53-56; July 15, 1931, pages 41-43; Aug. 1, 1931, pages 53-56; Oct. 1, 1931, pages 51-53, 56; Oct. 15, 1931, pages 34-36, 38.

The causes of 50 defective castings were analyzed and found to be due, in the majority (44) of cases, to faulty molding practice. The importance of proper arrangement of patterns and disposition of the gate or gates, their shape, size and positions is noted and illustrated by examples. Interesting results were obtained with a system of small gates and slow pouring. The nomenclature of foundry terms is explained. Ha (22)

Corrugated Pipe Pattern Forms Mold and Core. PAT DWYER. *Foundry,* Vol. 59, June 15, 1931, pages 57-60.

Describes the molding and pouring at the American Castings Co., Birmingham, Ala. Ha (22)

Bronze Pressure Castings Require Exact Practice. J. E. CROWN. *Foundry,* Vol. 59, June 15, 1931, pages 39-40. *Metal Industry,* London, Vol. 39, Aug. 7, 1931, pages 127-128.

The importance of such factors as selection of alloys, design of patterns, method of molding, character of cores and type of heads and gates in the successful production of bronze pressure castings is noted by a description of the practice employed in the U. S. naval gun factory. The analyses of several alloys which are applicable are given. Ha+PRK (22)

Bond Fitting Cores with Cement. PAT DWYER. *Foundry,* Vol. 59, Mar. 1, 1931, pages 77-80.

Melting and molding practice at the plant of the Walworth Co., Boston, is described and illustrated. Ha (22)

Recent Developments in Cast Iron and Foundry Practice in Great Britain. J. G. PEARCE. *Iron & Steel Industry & British Foundryman,* Vol. 4, July 1931, pages 329-332; Aug. 1931, page 377; *Foundry Trade Journal,* Vol. 44, June 25, 1931, pages 436-438; Vol. 45, July 9, 1931, pages 21-24, 27.

Condensed article from the Institute of British Foundrymen. The work at the British Cast Iron Research Association is briefly reviewed. "Balanced blast" cupola is described. Controlled cast iron may, possibly, be produced by completely removing graphite and then inoculating the melt with material calculated to yield fine pearlite and normal graphite. See also *Metals & Alloys,* Vol. 2, Nov. 1931, page 280. CHL+OWE (22)

The Laboratory and the Foundry. R. ARZENS. *Iron & Steel Industry & British Foundryman,* Vol. 4, Aug. 1931, pages 364-370.

General. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 279. CHL (22)

The Best Practice in Casting Bronzes. *Brass World,* Vol. 27, Aug. 1931, pages 181-183.

A report of the Non-Ferrous Committee on recommended practices at the meeting of the American Foundrymen's Association in Chicago, Ill., May 4-7, 1931, is reviewed. Tentative recommended practice for the alloy; Cu 85, Sn 5, Pb 5, Zn 5 are shown. Physical properties for sand casting are tabulated. Recommended practice for manganese bronze and for the alloy containing Cu 80, Sn 10 and Pb 10 is also discussed. WHB (22)

Patternmaking and its Relation to Design and Foundry Practice. MATTHEW RUSSELL. *Canadian Foundryman,* Vol. 22, May 1931, pages 12-14.

An article in which the question of designing castings to compete with welding is dealt with in some detail, and in which methods of designing patterns for various purposes are discussed. The article is accompanied by 13 diagrams. See also *Metals & Alloys,* Vol. 2, Nov. 1931, page 280. OWE (22)

Improvements in Physical Properties in Large Carbon and Alloy Castings. J. D. FENSTERMACHER. *Steel Founder,* Vol. 2, June-July 1931, pages 4-7.

The principles of good alloy steel casting—(1) the production of a metal of predetermined quality, (2) good foundry practice, (3) proper heat treatment—are set forth and several very large castings are illustrated. From 59 heats made by the Columbia Steel Co. of Pittsburgh, the weights of the pieces varied between 40,000 and 64,400 lbs. The ultimate strength was, on the average, 75,800 lbs./in.^{2}; elastic limit, 44,100 lbs./in.^{2}; elongation in 2 in., 30.5%; the reduction in area, 48.5%. Ha (22)

Stainless Steel Castings Need Fine Facing Sands to Obtain Smooth Finish. EDWIN BREMER. *Foundry,* Vol. 59, Feb. 15, 1931, pages 38-42.

The melting and pouring practice of the West Steel Casting Co. for stainless steel castings is described; the standard 18-8 alloy is usually used. The material is produced in the electric furnace; all scrap is employed without any addition of Ni; the bath temperature is raised to 3200° F. as rapidly as possible; and the liquid metal is tapped from the furnace into 2000-lb. bottom-pour ladles. The precautions necessary in melting to obtain the dissociation of C from Cr and to form austenite are described. Ha (22)

Addition of Fluorspar to the Cupola (Addition de spath fluor au cubilot). D. Deuvorst. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée. Section de Métallurgie,* 6th session, Liege, June 1930, pages 785-790. 14 references.

Compares use of 3% limestone on weight of Fe with that of 2% limestone, plus ¾% fluorspar. No difference was found in composition of gas, Fe or slag. More coke was recovered unburnt without spar than with it. The use of spar injures the lining and the fume is harmful to vegetation. See also *Metals & Alloys,* Vol. 2, Dec. 1931, page 321. HWG (22)

Preparation and Distribution of Molding Sands. H. L. McKinnon. *Iron Age,* Vol. 128, July 30, 1931, pages 312-313.

The quality of the work produced and profits secured from operations depend on the proper handling of the 2 activities. A thorough description of methods and apparatus for handling and preparation of sand is given. Ha+VSP (22)

Outlines Methods for Making High-Test Gray Iron in the Shop Making Machine Tool and Jobbing Castings. L. M. Sherwin & T. F. Kiley. *Foundry,* Vol. 59, July 1, 1931, pages 45-48; July 15, 1931, pages 47-49.

Internal shrinkage, sponginess and porosity can be eliminated by the use of low C cast iron. Chills are used sometimes, particularly if the casting has sections less than ¼ in. Methods of control, typical analyses of product and microstructures are discussed. Compares machining strength and other physical properties of a number of mixtures. Using up to 2% Mo, the following results are obtained: (1) the combined C is raised, but not above eutectoid; (2) the transverse strength is increased; (3) Brinell hardness is increased; (4) solid contraction is decreased; (5) pearlite is sorbitized; (6) graphite flakes are made smaller; (7) deflection is increased. Part 2. Main purpose of Ni in castings is to aid machinability. The use of ferrosilicon to 1.25% causes shrink holes. Cr is added to Fe used for high temperatures. Castings of high test Fe offer more resistance to tool penetration but are free from hard spots. Dry sand molding is followed in production of high test Fe to insure sound and good surfaced casting. VSP (22)

Physico-Mechanical Testing of Sands (Analyse physico-mécanique des sablés). Andre Guedras. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, May 1931, pages 239-242.

Moisture in foundry sand can be determined in 20-25 min. by a new method. To a 100 gm. sample of foundry sand, are added 200 cm.^{3} xylene or toluene. This mixture is heated in a closed vessel to boiling temperature. The water will begin to evaporate first, followed by the xylene. The condensed mixture of the 2 liquids is collected in a graduated cylinder. As these 2 liquids do not mix, they separate into 2 distinct layers, from which the percentage of moisture could be measured. Determination of silica, clay and of the colloidal matter is carried out on the same sample of sand. This analysis requires use of $CaCl_2$ solution of 1.12 specific gravity and alcohol. GTM (22)

Studies on the Filling Frame of Molding Machines. (Studien über den Füllrahmen an Formmaschinen.) A. Rodehueser. *Giesserei-Zeitung und Giesserei,* Vol. 18, Feb. 6, 1931, pages 116-124.

To obtain a certain uniform denseness in molding boxes, the molding box must have a definite height which can either be calculated or be determined graphically from diagrams which are developed. Differences in the denseness, due to the shape of the pattern, can be equalized by calculable differences in the height of the molding sand or in the dimension of the pressure plates. Certain axioms are developed which, if observed, reduce the molding time and guarantee a more uniform product. In this manner the economy of pressure molding machines is increased. Several examples illustrate the procedures. Ha (22)

The Structure of the Compressed Molding Sand and Its Importance in the Testing of Compressed Molding Sand. (Der Aufbau des verdichteten Formsandes und seine Bedeutung für die Formsandprüfung.) W. Reitmeister. *Die Giesserei mit Giesserei-Zeitung,* Vol. 18, Mar. 1931, pages 257-260.

First the conception of "structure" of the sand is defined as the volumetric ratio of the constituents of the sand to the volume of the grain of condensed sand. By considering humidity, grain and grain size, this factor is developed and tested for several kinds of sand and represented in diagrams. In this way the porosity and volume of pores can be exactly defined. Ha (22)

The Moore Hot-Blast Cupola. Jas. T. MacKenzie. *Transactions & Bulletin American Foundrymen's Association,* Vol. 2, Aug. 1931, pages 197-204; *Foundry Trade Journal,* Vol. 45, Sept. 10, 1931, pages 165-166.

Description of the installation and operating records showing variations in the temperature and amounts of coke consumed with the hot-blast cupola is given. Comparisons are made with the hot-blast and cold-blast cupola processes. OWE+CHL (22)

A Note Upon the National Position of Metallurgical Knowledge and Efficiency in Ordinary Iron Foundries. Horace J. Young. *Foundry Trade Journal,* Vol. 45, Dec. 10, 1931, pages 366-368.

A discussion of the characteristics of the average foundry, followed by suggestions as to the economies and advantages of metallurgical standardization and control. Points out that expensive raw materials are usually unnecessary in foundry practice but that scientific mixing of the ingredients is essential. Some discussion of the solution of graphite in molten pig iron and of pig-iron composition closes the paper. OWE (22)

Wrought-Iron Core Support in Gray Iron (Flusseisenkernstütze im Grauguss). M. von Schwarz & H. Schropp. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Sept. 11, 1931, pages 725-731.

A series of micrographs show the structure of a core support which has become an integral part of the surrounding cast iron. On the basis of these micrographs, the phenomenon is discussed in detail. Ha (22)

FURNACES & FUELS (23)

Industrial Gas and Electric Furnaces. E. Gossow. *Engineering Progress,* Vol. 12, Oct. 1931, pages 217-222.

A general survey of operating characteristics and classification of industrial furnaces. The furnace atmosphere, fuel gases and burners are discussed and a few large installations are described. Ha (23)

The Problem of Melting Furnaces for the Iron Foundry (Le problème du four de fusion dans la fonderie de fer). T. Geilenkirchen. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 791-800. 12 figures.

Describes cupolas, reverberatories fired with different fuels, recuperative furnaces, the Brackelsberg powdered coal furnace and electric furnaces. For temperatures required by special irons, outside the range of the cupola, the Brackelsberg furnace is considered most promising for European conditions. The electric furnace is considered less suitable for average European conditions than for American ones. In discussion (page 851), Ronceray stated that the Brackelsberg furnace was not an improvement, and would not have a permanent place in the foundry, but Thomas and others defended it. HWG (23)

High Frequency Steel Furnaces. D. F. Campbell, *Chemical Age,* London, Vol. 23, Metallurgical Section, Oct. 4, 1930, pages 19-20.

Iron & Steel Institute paper, Sept. 16, 1930, at Czechoslovakia. See *Metals & Alloys* Vol. 2, Jan. 1931, page 16. VVK (23)

Some Experimental Data on the Influence of Dry and Wet Cleaning on Coke Properties and on Gas and By-Product Yields. A. C. Fieldner. *Report of Investigations* 3114, *United States Bureau of Mines,* May 1931, 9 pages; *Fuel,* Vol. 10, July 1931, pages 320-327.

Within the moisture limits of the coals tested (4.2% maximum moisture) there was no difference observed in the effect of dry or wet cleaning on the coke, gas, or by-products. In the plant tests, the nut and range size of coke showed from 1.3 to 2.9% more of ash than the stove size from the screened lump coal, whereas the washed coal showed an increase of 0.2 to 0.8%, indicating that the free impurities tend to segregate in the smaller sizes. The heating value and the cubic-foot yield of gas from the washed coal is greater than from the unwashed, and in slightly greater proportion than that due to the difference in the diluents, ash and moisture. The yield of tar and light oil is higher from washed coal than from unwashed, even after allowing for the difference in ash and moisture. A high percentage of mineral matter in the coal appears to promote cracking of tar. The yields of ammonium sulphate in the iron-retort tests were materially less from the washed coal containing 4% of moisture than from the unwashed coal containing 1.2% of moisture. But in the laboratory silica-tube tests the yields were slightly higher from the washed coal. It is believed that the silica-tube results for ammonia are more indicative of the practical results because of the known catalytic effect of hot iron on the decomposition of ammonia. These conclusions apply to washed coal containing not over 4% of moisture. Further experiments should be made with increasing percentages of moisture to determine its effect, and likewise with different sizes and kinds of impurities with reference to their effect on coke structure. Changes in size may reverse the effect, as in the case of fusain. Large pieces of fusain mixed with coal weaken the coke, whereas finely divided fusain mixed with strongly fusing coal improves the physical properties of the coke. WAT (23)

An Electric Reflection Furnace (Ein elektrischer Reflexionsofen). C. Benedicks & J. Härden (Metallografiska Institutet Stockholm). *Zeitschrift für technische Physik,* Vol. 12, Apr. 1931, pages 234-243.

The authors designed an electric reflection furnace mainly consisting of an elliptical mirror of Cu and an electric arc and claim the following advantages: (1) non-conducting materials are melted without being in touch with foreign matter (crucible walls); (2) extremely short time required for running up to the melting point; (3) temperatures higher than 2000° C. (about 3620° F.) are easily attained; (4) utilization of the equipment for melting in vacuo. Experiments were carried out with the object of determining the efficiency of the new furnace. The best result yielded 25% of the input (energy required for the electric arc); presumably the Cu-mirror was in a highly polished state. Data of the water-cooled Cu-mirror: 42 cm. diameter, 14.5 cm. focal distance, Cu sheet of 1.5 mm. thickness. See also *Metals & Alloys,* Vol. 2, Dec. 1931, page 322. EF (23)

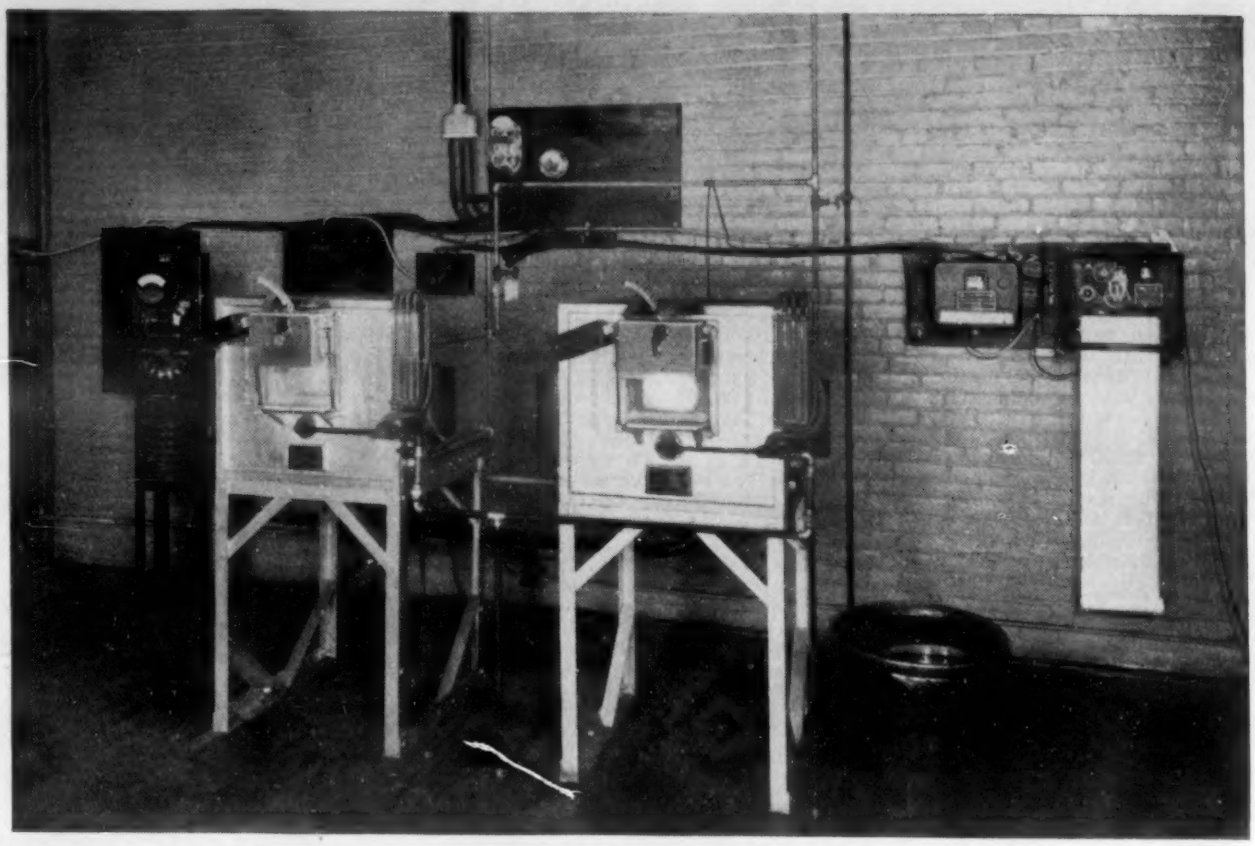
Produces Special Purpose Iron in Rotary Furnace. *Foundry,* Vol. 59, July 1, 1931, pages 49-52.

Rotary furnace fired with powdered fuel is developed in Germany. It is designed for the production of high grade iron castings and alloy gray iron castings containing Ni, Cr, V, Mo, Cu, Mn, etc. Also used for the production of malleable iron. Characteristic of the furnace is the high grade of Fe produced. Tabulates results of tests made on standard arbitration bars known as the A.S.T.M. specification A49-29. The furnace is designed as a flexible unit. VSP (23)

Development in By-Product Coke Production. A. C. Fieldner (U. S. Bureau of Mines). *Iron Age,* Vol. 128, July 16, 1931, pages 165, 207.

Abstract of a paper read before the American Society of Mechanical Engineers at Chicago. Early manufacture of blast furnace coke in beehive ovens was an enormous waste. In 1929, 90% of the production was in by-product ovens. By-product ovens have not only displaced beehive ovens in producing metallurgical coke, but they are supplying base-load gas in conjunction with coke for domestic fuel. Further developments may be checked in certain localities served by long distance natural gas pipe lines. S recovery purification process promises to give new by-product S adapted to fungicidal and agricultural purposes. Phenol is being recovered in salable form. VSP (23)

In These Two "Globar" Equipped Furnaces Some Heat-Treating History Was Made



THE completed report on a series of furnace demonstrations made some months ago in Cleveland goes far indeed in establishing more outstanding records for Globar Brand Elements, the Hayes Furnace and treating by electric heat.

Sixty-six practical demonstrations were made—metallurgists, heat treaters, plant executives—steel men—came either to run or supervise the operation of these furnaces.

They brought their own tools—everything from the most delicate cutters and reamers to drills, heavy forming tools and dies.

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And the results?

Well, in many instances, they were astonishingly successful.

The "Globar" equipped Hayes Furnaces with atmospheric control, heat-treated high speed saws without scale—without warpage—high speed threading dies came out perfectly hardened—chasers and dies clean, unscaled, with a Rockwell as high as 65–67.

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Factors Influencing the Design of Normalizing Furnaces. E. E. Griffiths. *Heat Treating & Forging,* Vol. 17, Feb. 1931, pages 173-176; *Sheet Metal Industries,* Vol. 4, Jan. 1931, pages 759-765.

General requirements for all normalizing furnaces include: (1) they should be capable of heating the sheets above their A_3-temperature; (2) the rate of heating and cooling should be controllable; (3) each individual sheet of any particular gage and specification should be treated alike. The surface of the sheets must not be damaged by scratching, pitting or oxidation. The sheet should be delivered from the furnace as flat as possible. The principal types of present normalizing furnaces are the rotating disk conveyor, the walking-beam conveyor, the continuous conveyor. The design, heat insulation, recuperation, mechanical upkeep and operating costs are discussed and curves showing the absorption of heat by sheets and furnace walls and the losses through the latter are given. See also *Metals & Alloys,* Vol. 2, Mar. 1931, page 75. AWM+Ha (23)

A New Experiment to Demonstrate the "Pinch" Effect (Ein neuer Versuch zur Demonstration des "Pinch"-Effektes). E. Blaich. *Elektrotechnische Maschinenbau,* Vol. 48, Dec. 7, 1930, pages 1083-1085.

An experiment is described in which a fiber cylinder filled with Hg was used. The Hg represented the molten metal in the induction furnace. When an alternating current of sufficient strength was sent through the metal, forces were generated which made the metal rise or fall in the communicating U-tubes and a complete circulation could be obtained. This is due to a contraction or pinching effect at certain points and is accompanied by violent local currents in the molten metal. Electromagnetic forces are the cause of this phenomenon. The theory for the calculation of the forces created is briefly developed. Ha (23)

New Economies from an Old Furnace. G. M. Bayne (Canadian Westinghouse Co.). *Electric Journal,* Vol. 28, Nov. 1931, page 640.

The conversion of porcelain enamelling furnace from oil to electric operation has shown surprising economies in at least one recent case. A Canadian manufacturer found more even distribution and closer control of heat, resulting in a 75% reduction in rejects, less warpage and a better and more glossy surface on the enamelled parts. Other advantages include: a thinner coat of enamel, and clipping is reduced. No repairs have been necessary in 1 year's operation. WHB (23)

Testing and Rating of Fuel-Fired Industrial Furnaces. Part XVIII. W. C. Buell, Jr. *Fuels & Furnaces,* Vol. 8, Nov. 1930, pages 1495-1498; Dec. 1930, pages 1645-1648, 1659.

It is shown how a heat balance is made up of the whole furnace and its parts. Ha (23)

Industrial Heating. W. E. Swale. *Electrical Review,* Vol. 108, June 19, 1931, pages 1051-1052.

The supply of electric power to heating and furnace installations in its reaction on the power supply and rates charged for it are discussed. A table gives load factors and operating features of furnaces and ovens of various industrial undertakings. Ha (23)

Successful Open-Hearth Furnace Operation with Coke Oven Gas. A. J. Ebner. *Freyn Design,* No. 9, Oct. 1931, pages 5-7.

A group of 9 furnaces in the Hoesch Steel Works, Dortmund, Germany, consisting of 5 30-ton units, 3 of 100 tons and one 150-ton unit (the last of the tilting type) use from 9300 to 10,400 ft.^{3} of coke oven gas/gross ton of steel produced; the gas has a heat value of 527 B.t.u./ft.^{3}. These figures cover the entire campaign including all gas used in the furnaces. The charges consist of 75% scrap and 25% iron, of which approximately 85% of the heats use hot metal and the remainder, cold pig. Water cooling of doors, frames and ports requires an average of 1580 gals./ton of steel. The 100-ton furnaces make 3.3 heats a day, or 15.5 tons/hr. The hearth load is 68 lbs./ft.^{2}/hr. After a period of 1200 heats, the checker bricks must be renewed. A drawing of the construction of a furnace is reproduced. Ha (23)

Some Future Fuel Problems in Metallurgical Practice. H. C. Armstrong. Paper before *Third International Conference on Bituminous Coal* in Pittsburgh, Pa.

The author discusses, from the British viewpoint, the problem of coal and its eventual replacement by another fuel. The exhaustion of the better qualities of coal with low S will compel either the use of a method to eliminate the deleterious effect of the contact of steel with S gases (in the blast furnace and Siemens melting furnaces) or a changing over to other fuels and, perhaps, other furnace designs. The economical factor will be of determining influence. Ha (23)

Automatic Control of Blast Furnaces Gains Favor. *Steel,* Vol. 88, Jan. 1, 1931, pages 291-294.

The achievements of the blast-furnace industry in 1930 include decreased flue dust losses and fuel consumption, wider use of blast furnace and coke oven gas mixtures for heating open-hearth furnaces and coke ovens, extensive adoption of hot blast stoves, construction of stationary towers and gas washing equipment and an increase in the number of sintering plants for treating ores high in moisture, S and percentage of fines. A great advance was the installation of turbo-blowers up to 110,000 ft.^{3} capacity with complete remote, automatic volume indicators and volume control. Complete automatic control and operation of the furnace stock house was accomplished, including recorders to mark the operation of top, skips, stock line and bin gates. The full automatic charging of coke by weight and by volume was also achieved. The tendency to increase the hearth diameter of the blast-furnace without materially increasing the stock line diameter has resulted in less economical practice. JN (23)

Practical Applications of Heat in Metallurgy. H. Dobbin. *Iron Age,* Vol. 128, July 16, 1931, pages 180-181, 208.

A general discussion of combustion problems, reducing atmospheres, etc. The author's aim is to show the means by which, with proper equipment and arrangement, savings may frequently be realized. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 189. Ha (23)

Controlled Atmospheric Steel-Hardening Furnaces. *Industrial Chemist,* Vol. 7, June 1931, pages 256-257.

A brief description of a new-type Birlec furnace designed to operate at temperatures up to 1350° C. The heating elements are "Globars" located at the sides of the furnace and extending from front to back. RAW (23)

Electric Heating Furnaces. *Metallurgia,* Vol. 4, May 1931, pages 1-3.

A description of some of the large heat-treating furnaces made by the Hevi Duty Electric Co. JLG (23)

Metal Processing with Electric Furnaces. *Brass World,* Vol. 27, Oct. 1931, page 223.

The Process Engineering & Equipment Corp., Attleboro, Mass., manufactures an electric furnace applicable to various processes such as bright annealing in one operation. The furnace known as "Preeco" employs a special atmosphere for bright annealing such products as strips, blanks, stampings and wire of such metals as brass, steel, sterling, Cu, Ni-silver, phosphor-bronze and other alloys. Cu-brazing may be carried out without drilling, tapping, riveting or welding to produce tight joints in a wide variety of metals. Bright Ag soldering is accomplished in this furnace. The furnace is illustrated. WHB (23)

Industrial Resistance Electric Furnaces (Le four electrique a resistance a usage industriel). *Journal du Four Electrique,* Vol. 40, July 1931, pages 281-287.

A general survey of the possibilities of electric resistance furnaces for industrial applications and a brief description of muffle furnaces, salt bath furnaces, high temperature furnaces both with liquid resistor and with silite elements manufactured by Siemens Co. JDG (23)

An Inexpensive Electric Furnace. *Electrical Review,* Vol. 108, June 5, 1931, page 944.

Complete winding and building data for an electric resistance furnace for temperatures up to 900° or 1000° C., at 110 V. and 60 amp. The furnace can operate under vacuum. Ha (23)

Perfect Electric Galvanizing Furnace for Wire. *Canadian Foundryman,* Vol. 22, Apr. 1931, page 11.

Brief description, accompanied by 1 photograph, of an electrically heated and controlled furnace operating at the Hamilton (Ontario) plant of the Frost Steel and Wire Co., Ltd., for the continuous galvanizing of steel wire. OWE (23)

Induction Furnace with an Automatic Temperature Control by Means of a Ferro-Magnetic Muffle. (Four a induction a moufle ferro magnétique autorégulateur de température.) R. Perrin & V. Sorrel. *Revue de Metallurgie,* Vol. 28, Aug. 1931, pages 448-452; *Aciers Speciaux, Metaux et Alliages,* Vol. 6, July 1931, pages 352-353.

The use of magnetic induction permits the very accurate regulation of the temperature ranges of a muffle furnace in which the muffle itself acts as a heat generating unit. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 280. GTM+JDG (23)

Continuous Furnace for Normalizing Sheets. *Iron & Coal Trades Review,* Vol. 122, Apr. 10, 1931, pages 581-582.

The hearth of this furnace is moved in strokes of 2 ft. each by hydraulic power at 750 lbs./in.^{2} The output is about 2 tons/hr. There is no water cooling; the fuel consumption is less than 1¾ cwt. (196 lbs.) coal/ton of sheets normalized. The furnace is in operation at the plant of John Lysaght, England. Ha (23)

Rotary-Hearth Furnace for Annealing. *Iron Age,* Vol. 126, July 10, 1930, page 97.

Describes motor driven furnace having rotating hearth for open or box annealing, or carburizing. It is made by King-Taudevin & Gregson, Sheffield. This design is being introduced into the U. S. by the H. L. Dixon Co., Pittsburgh. Port arrangement, use of recuperators and of gas and air control effects a low fuel consumption even with reduced atmosphere. Furnace is generally designed for producer gas fuel, although natural gas, oil or tar may be used. Approximately 225 lb. of coal/gross ton of steel, not including boxes, is average figure for English practice. VSP (23)

Rotary Hearth Furnace for Heat Treating. R. E. Barker (H. L. Dixon Co.). *Heat Treating & Forging,* Vol. 16, Sept. 1930, pages 1189-1190; condensed in *Fuels & Furnaces,* Vol. 8, Sept. 1930 pages 1257-1258; *Steel,* Vol. 87, July 1931, page 51.

Describes furnace designed by King-Taudevin & Gregson, Ltd., Sheffield, England, in which low fuel consumption is effected by improved port arrangement. Any degree of reducing atmosphere may be obtained by accurate control of air and gas supply. This has increased the life of the pots at least 6 times. Furnace is generally designed for producer-gas, although construction may be modified for natural gas, oil or tar. MS (23)

Industrial Furnaces for Gas. IX. Small Forge Furnaces. X. Large Forge Furnaces. Lawrence Biemiller, *American Gas Journal,* Vol. 135, Oct. 1931, pages 68-69; Nov. 1931, pages 62-63.

IX. The design and construction of small forges is discussed. Suggested uses are: tool dressing, hardening, annealing, and brazing. Gas has been used extensively in this type of furnace owing to its convenience and the ease of its use. Oil is often used in larger forges. X. Since large special forge furnaces handle large tonnages of metal and use large quantities of fuel, the most important features of furnace design such as material handling equipment, automatic temperature control, automatic furnace pressure control, efficient insulation, preheated air and refractories of long life are necessarily observed. Small billets, up to 6 or 8 ins. in each dimension are often heated in a rotary hearth furnace. Medium sized billets are handled in "straight thru" furnaces whereby the billets are pushed by mechanical or hydraulic pushers over water cooled skid rails. The walking beam furnace is also used extensively especially for heating brass billets. A very complete description of the design and operating data of this type of furnace is given. Very large individual forgings such as the forging for a reaction chamber of an oil cracking unit (which is 45 feet long, 6 feet in diameter inside, with walls 6 inches thick), are often heated in large oven furnaces, sometimes of a temporary construction. CBJ (23)

Coke-Oven and Blast-Furnace Gases for Metallurgical Furnaces. *Iron & Coal Trades Review,* Vol. 123, Oct. 2, 1931, pages 506-507.

Some recent developments in Germany are described and the installations are illustrated. Ha (23)

The Reactivity of Coke Coated with Lime and the Production of Low-Carbon Iron in the Cupola. *Foundry Trade Journal,* Vol. 45, Sept. 3, 1931, page 151.

Translation of an article by E. Piwowarsky which appeared in *Die Giesserei.* Piwowarsky has shown that it is not correct to assume that coke is rendered less reactive with carbon dioxide by coating it with lime. A series of experiments are described with the object of supporting this contention. The article also refers to Corsalli's criticisms of Piwowarsky's results, which appeared in a later issue of the German journal. Corsalli opines that the behavior of lime-coated large-size coke cannot be compared with that of small pieces, such as were used in Piwowarsky's experiments. Further, the method usually adopted in treating coke with lime is not as simple as that suggested by Piwowarsky; in fact, coke may be protected by lime to such an extent as not to be burned at all in the cupola. OWE (23)

Investigations on the Coking Power and the Swelling of Coal. H. A. J. Pieters. *Fuel,* Vol. 10, Nov. 1931, pages 484-488.

A method is described for the determination of the velocity of gas evolution from coal which is being heated at a constant rate, which appears to be a valuable characteristic of coal. The velocity of gas evolution attains some typical maxima corresponding with (a) the loss of water, (b) the decomposition during the period of low temperature carbonization, (c) the carbonization of semi-coke. All good coking coals show a characteristic maximum in the velocity of gas evolution at about 480° C. Poorly coking coals are decomposed at a more constant rate. WAT (23)

A New Cyanide Furnace. R. F. James & Glenn Coley (Detroit Edison Company). *Journal Franklin Institute,* Vol. 211, Mar. 1931, pages 327-334.

Illustrates new electrically heated cyanide pot for hardening steel. The heating element is made of usual Cr-Ni alloy. With electrical input of 43 kw. after 1800 work hours, no deterioration of elements had occurred. Used for hardening steering gear sectors, this furnace consistently produced over 4 lbs. of work/kwh. The writers found that (1) cyanide or its components have a harmful effect upon Cr-Ni alloys; (2) the reaction between these 2 materials increases rapidly with an increase in temperature and 1650° F. is the maximum safe temperature for economic operation; (3) it is not economically practical to exclude cyanide or its components from the element chamber; (4) the deterioration of Cr-Ni heating elements heated in air is exceedingly slow (at temperatures below 1800-2000° F.) DTR (23)

Tonnage Melting by Coreless Inductions. E. F. Northrup. *Fuels & Furnaces,* Vol. 9, Apr. 1931, pages 473-478; May 1931, pages 603-605; June 1931, pages 711-715; July 1931, pages 833-838; Aug. 1931, pages 923-928; Sept. 1931, pages 1067-1072.

The coreless induction furnace is most appropriate for the production of C-free metals and alloys because no C is used, either as electrode or in any other way. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 281. Ha (23)

REFRACTORIES & FURNACE MATERIALS (24)

Silicon Carbide and Its Application in Metallurgy. H. R. Houchins & C. McMullen (Carborundum Co.). *Metals & Alloys,* Vol. 3, Jan. 1932, pages 12-14.

6 references are cited. Application of silicon carbide as a resistor material in heat treating furnaces operating at temperatures higher than ordinary metal resistors will stand is discussed. Use of carborundum in recuperators, combustion chambers, and muffles is efficient on account of the refractoriness of the material and its high thermal conductivity. It does not store up quantities of heat. Lesser uses as bonded brick in non-ferrous melting furnaces, in graphite crucibles, and as an outer protection tube for thermocouples are described. WLC (24)

The Manufacture of Magnesite Bricks. *Chemical Engineering & Mining Review,* Vol. 23, June 5, 1931, pages 335-336.

A deposit of magnesite near Attunga, N.S.W. is now the main source of supply for magnesite brick manufacture in Australia. Austrian and Attunga dead-burnt magnesites are compared in chemical analysis. The Austrian product contains about 7% Fe_2O_3, which lowers the temperature at which the material will sinter during calcination and acts as a bond. The Attunga magnesite with a bond of mill scale was found to make excellent bricks. The manufacture is reviewed. WHB (24)

Control and Testing of Refractories in Gas-Works. M. G. Charlet. *Gas Journal,* Vol. 194, June 10, 1931, page 831.

Reviews paper presented before the Annual Congress of the Association Technique de l'Industrie du Gaz en France, Apr. 21 to 25, 1931. The object of the tests is 2-fold: first, the control of the quality of the standard materials employed, and second, the investigation of new products. Cracks, flaws and inclusions of fusible matter and dimensions are checked and inspected. MAB (24)

Steel Industry Favors Dolomite and Chromite Refractories over Magnesite. *Brick & Clay Record,* Vol. 79, July 28, 1931, pages 80, 82.

Statistics reveal, at present, a preference for dolomite and chromite materials. Of these, about 40-70 lbs. of dolomite/ton of steel is at present used as a patching material. Ha (24)

Crucibles of Graphite. (Über Graphit-Tiegel). E. R. Thews. *Tonindustriezeitung,* Vol. 56, Jan. 14, 1932, pages 60-62.

The composition and properties (resistivity against chemical attack and heat, heat conductivity etc.) of the many types of graphite crucibles are described as they are used for metallugical purposes. Some important points which are to be observed in the manufacture of crucibles are discussed. GN (24)

INSPECTION (26)

Magnetic Inspection of Rails. *Metallurgist,* Dec. 1930, pages 189-190.

Acoustical, electrical and magnetic properties of rails have been used for detecting defects. The Sperry electrical method is quite well known in America. The magnetic method has been more widely used in England. The leakage of magnetic flux is measured or looked for rather than the determination of total internal flux. This leakage method appears especially applicable for detecting cracks and fissures. In one form of test, the rail or other part is suitably magnetized and then treated with finely divided iron particles suspended in a liquid medium, by pouring the liquid mixture over or spraying it on to the surface. Where leakage occurs, as it does at a fissure, the magnetic poles attract the iron particles, which collect about them. Fine cracks, difficult or impossible to detect by visual inspection, can be revealed in this way on smooth surfaces. This method is now in use in England by railway and motor transport companies for regular inspection of important steel parts, such as wheel axles, liable to failure through fatigue cracking. In another form of test, the leakage flux is detected electrically by means of current induced in a traversing search coil when it encounters the magnetic leakage field. This form of test has been developed particularly for testing rails *in situ.* A portable apparatus, developed by Suzuki in Japan and recently mounted by Sakurai on one continuously moving truck is described. VVK (26)

The Spark Test as a Production Tool. A. K. West. *American Machinist,* Vol. 75, July 9, 1931, pages 72-74.

The nature and shape of sparks produced when grinding permit the differentiation and distinguishing of alloy steels. A few photographs illustrate some typical examples. Ha (26)

A Mirror Comparator for Production Inspection. O. P. van Steewen. *American Machinist,* Vol. 75, Sept. 10, 1931, pages 417-418.

A combination of optical and mechanical transference produces a magnification of 1000:1, so that an error of 1/1000 in. would show 1 in. deflection in the microscope. Arrangement of the device on the work piece is illustrated. Ha (26)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

The Influence of Third Metals on the Constitution of Brass. III. Influence of Tin. (Der Einfluss von dritten Metallen auf die Konstitution der Messinglegierungen, III Der Einfluss von Zinn). O. Bauer & M. Hansen. *Mitteilungen der deutschen Materialprüfungsanstalten,* Sonderheft 17, 1931, pages 3-20.

Attention was confined to the region between 52 and 66% Cu, 0.5 and 5% Sn, 33 to 47% Zn. The diagrams and conclusions of previous workers are discussed. In the experimental work, 30 alloys were studied by thermal analysis and microscopically examined after long annealing and quenching from 800°, 700°, 600°, 575°, 550°, 525°, 500°, 475°, 450° and 400° C. The ternary equilibrium diagram is shown and many pseudo-binary diagrams plotted for constant Cu and Sn content. Sections of the ternary solid diagram are shown for the different quenching temperatures. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 250. HWG (27)

Some Uses of Aluminum in Steel. W. F. Darch. *Western Machinery World,* Vol. 22, Dec. 1931, pages 570-572.

Lightness, electrical and thermal conductivity, ability to resist corrosion, high ductility and strength when alloyed with small amounts of certain other metals and heat treated have combined to place aluminum in a prominent position in the manufacture of steel. Calorizing is reviewed. Aluminum is an important constituent in the thermit-welding process. Aluminum is a necessary element in steels which are to be successfully nitrided. WAT (27)

Nickel Cast Iron in the Automotive Industry. Thos. H. Wickenden. *Nickel Cast Iron News,* Vol. 2, Aug. 1931, pages 3, 10.

A few cast iron compositions with Ni additions for cylinder block specifications are given. The advantages of adding Ni either alone or with other alloying elements are: (1) refining the grain by producing finer graphite flakes and securing a high lustre on a finished surface; (2) reduction of porosity and internal shrinking resulting in pressure-tight castings; (3) eliminating chilled corners and edges and other spots in gray iron, thereby improving the machinability; (4) increasing the hardness of gray iron, especially in heavy sections retaining the machinability above 300 Brinell; (5) equalizing the hardness in thick and thin sections, resulting in reduction of casting strains and resulting warpage; (6) securing great resistance to wear and abrasion; (7) Securing stability of composition, strength and hardness at elevated temperatures. The particular advantage for use in brake drums is noted. Ha (27)

How Silica and Silicon Affect Die Casting Machineability. G. L. Werley & E. A. Anderson. *Iron Age,* Vol. 128, July 16, 1931, pages 183-186.

Describes experiments conducted on alloy containing 4% Al, 3% Cu, 0.1% Mg and the balance high grade Zn, commonly known as "4-3-0.1" alloy. Castings containing 0.38% silica dulled tools rapidly. Even castings containing 0.01% silica were injurious to the tools. Silica is not detrimental to tensile strength and Brinell hardness. Neither is it soluble in 4-3-0.1 alloy. Si has no appreciable effect on the machinability of Zn alloy die castings. Si may be oxidized to silica in the alloy. VSP+Ha (27)

Silicon and Manganese. (Silicium et Manganèse.) Try-Chalons. *Revue Fonderie Moderne,* Vol. 25, Sept. 10, 1931, page 334.

To obtain good quality of castings from a cupola furnace, the composition of the charge should be selected according to the thickness of the pieces to be cast and to the corresponding velocity of cooling. The contents of Si and Mn must be adapted correspondingly. A table showing the most suitable contents of Si and Mn for thicknesses from 3-50 mm. is given. For very low C, Si should be increased a little for thin castings. Ha (27)

INSTRUMENTS & CONTROLLERS (28)

Ladle Heat Measured Quickly and Accurately. R. D. Bean. (Brown Instrument Co.) *Metal Progress,* Vol. 20. Oct. 1931, pages 60-63, 104.

The author describes an immersion pyrometer for the measurement of the temperatures of foundry metals such as Al and brass with a discussion of the use of the instrument. WLC (28)

Measurement and Control of Temperature in the Hardening Shop (Temperaturmessung und -regelung in der Härterei). A. Grunwald. *Feinmechanik und Präzision,* Vol. 39, Oct. 1, 1931, pages 151-156; Nov. 1, 1931, pages 179-183.

The importance of exact temperature measurement and temperature control particularly in the hardening process is pointed out. The hardening heat must not exceed that which is absolutely necessary, it must last a certain time and only as long as all parts have assumed uniform heat, and tempering must be carried out at a certain temperature best suited for the particular steel. If these precautions are not observed, hardening cracks occur, the steel is overheated and is burnt, or an upsetting effect takes place. The instruments for the supervision of this process, radiation pyrometers, thermocouples, resistance thermometers, and their accessories are thoroughly treated; their principles are explained and connections illustrated. Ha (28)

Automatic Combustion Control Systems for Wire Furnaces. F. Aschner & H. Mayer-Witten. *Wire & Wire Products,* Vol. 6, Nov. 1931, pages 440-441, 446.

As the economy of the process and the quality of the production in the manufacture of wires depends greatly on the uniformity of temperature, the control of furnaces has become of utmost importance. In this article automatic controlling systems and the types of regulators used in Germany are described; full layouts are given and installations illustrated. Ha (28)

Recent Advances in Pyrometry. Ezer Griffiths. *Journal Institute of Metals,* Vol. 47, June 1931, pages 1-4.

This review covers recent progress in pyrometry, particularly high-temperature measurements of the melting points of metals. For the calibration of instruments, several points of the International Scale are available:

Temperature of freezing Zn	419.45° C.
Temperature of freezing Sb	630.5° C.
Temperature of freezing Cu in a reducing atmosphere....	1083° C.
Temperature of freezing palladium	1555° C.
Temperature of melting W	3400° C.

Thermoelectric recorders and optical pyrometers are described and surface pyrometers and accessory apparatus and a high-frequency furnace for obtaining high temperatures are treated. Ha (28)

Temperature Measurements of Liquid Copper and Its Alloys (Ueber Temperaturmessungen an flüssigem Kupfer und seinen Legierungen). H. Miething & Ch. Winkler. *Die Giesserei mit Giesserei-Zeitung,* Vol. 18, Feb. 27, 1931, pages 181-184.

Immersion pyrometers are subject to great wear and, therefore, are not suitable for a continuous supervision of the pouring temperature. For this reason, an attempt was made to determine how exactly radiation pyrometers indicate the temperature as the liquid metal cannot be considered a black body. The measurements described were made with a Holborn-Kurlbaum pyrometer on pure Cu, phosphor-bronze, bronze B, bronze 4, bearing bronzes and red brass, and brass. The exact analyses for these alloys are given. Where possible, several color filters were used. The corrections for the measurement at the free-radiating surfaces are determined and tabulated for all metals. The agreement with the immersion measurements are fairly good except for those metals which emit vapors when great differences due to absorption can take place. Ha (28)

On the Platinum Resistance Thermometry. Part 1. Calibration of Bridge and Annealing of Platinum Bulb. Part 2. Determination of Constants of Platinum Bulb and Accuracy of Resistance Thermometry. Mototaro Matsui & Shuu Kambara. *Journal Society of Chemical Industry,* Japan, Vol. 33, Oct. 1930, pages 401B-403B, 403B-407B.

The accuracy of resistance thermometry is 0.01° C. against temperature below 500° and 0.1° against temperature above 500°. They have not, however, a fixed point above 500° which, determined to 0.01° and to obtain any temperature above 500° which has reproducibility to 0.01°, is difficult. Hence the resistance thermometry may be said as the most accurate measurement of temperature at the present time. MAB (28)

Temperature Regulator for Melting Furnaces (Temperaturregler für Schmelzofen). H. Rechenberg. *Elektrotechnische Zeitschrift,* Vol. 52, Dec. 3, 1931, pages 1498-1499.

A platinum resistance in the furnace changes its resistance with the temperature and disturbs the balance of a Wheatstone bridge of which it forms one leg. The galvanometer is deflected and closes, according to the direction of the deflection the circuit of an amplifying tube which operates through a relay, a resistance in the heating circuit of the furnace. A curve of a run at 850° C. is given which shows deviations of less than $\pm$ 1° C. Ha (28)

Galvanizing Pot Temperature Control Made Automatic. H. R. Simonds. *Steel,* Vol. 89, Oct. 5, 1931, pages 39-43.

A brief description of pyrometric control of temperature of a few plants with galvanizing pots of 30 and 50 tons. The thermocouple is suspended over the edge of the pot and immersed in the molten zinc. Ha (28)

An Object Stage Which Can be Turned in Any Direction. (Ein allseitig drehbarer Objekttisch.) M. Straumanis. *Zeitschrift für technische Physik,* Vol. 12, Nov. 1931, pages 576-578.

The author designed a simple object stage which can be turned to any direction during crystallo-physical, crystallographic and metallographic work. EF (28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

Cold Treating Duralumin Rivets. Robert Johnson. *Metal Industry,* N. Y. Vol. 29, Sept. 1931, page 383.

Rivets of heat treated and quenched duralumin, when kept at 10° F, did not harden at the end of 1 wk. and at the end of 2 wks. had hardened only slightly. When housed in wooden boxes containing dry ice, such rivets are kept in condition for 1 day around a plant. PRK (29)

Engineering Requirements for Heat Resisting Metals. J. C. Woodson, *Heat Treating & Forging,* Vol. 17, July 1931, pages 700-705, 709; Aug. 1931, pages 796-799.

The application of such metals in metallurgical processes is discussed. Malleable and cast resistors for furnace resistor elements and their classification for use with different temperatures are described. Examples and compositions for different purposes are given and recommendations for future improvements are added. Ha (29)

Quick Determination of Limiting Creep Stress. Correspondence from W. Rosenhain, London, England. *Metal Progress,* Vol. 21, Feb. 1932, pages 65-66.

The writer discusses the intercrystalline failure of metals at elevated temperatures. The shortcomings of creep measuring devices described are pointed out. Kinship between this type of failure and fatigue is suggested. WLC (29)

The Coefficient of Expansion of Cast Iron. (Beitrag zum Koeffizienten des Gusseisens.) F. Roll. *Giesserei-Zeitung,* Vol. 27, Jan. 1, 1930, pages 4-7.

A review of the effect of temperature and alloying elements upon the coefficient of thermal expansion of cast Fe. (29)

Behavior of Some Irons and Steels under Impact at Low Temperatures. Robert Sergeson. *Transactions American Society for Steel Treating,* Vol. 19, Feb. 1932, pages 368-384.

Includes discussion. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 284. WLC (29)

Review of June 1931, Chicago (A.S.T.M., A.S.M.E.) Symposium on Effect of Temperature on the Properties of Metals. H. J. French. *Conference on Metals & Alloys, Case School of Applied Science, Cleveland, Ohio.* Paper No. 11, Nov. 1931. Mimeographed. 14 pages.

A general abstract of the Symposium papers. (See *Metals & Alloys,* abstract section, Vol. 2, Sept. 1931, pages 191-193; Oct. 1931, pages 231-232; Nov. 1931, page 283; Dec. 1931, pages 324-325 for abstracts of individual papers.) Ha+HWG (29)

Monel Metal and its Utilization at Elevated Temperatures. (Monel Metall. Über die Verwendung in der Wärmetechnik.) A. Schulze. *Die Wärme,* Vol. 53, May. 1931, pages 334-337.

The thermal and mechanical properties of Monel metal are briefly reviewed and its utilization as construction material is discussed with particular reference to turbine blades. EF (29)

Corrosion Problems Affecting Oil-Vapor Condensers. A. E. Pew. *Refiner & Natural Gasoline Manufacturer,* Vol. 10, May 1931, page 79.

Corrosion from the water side and oil side of condensers and the effect of modern design on the corrosive action are discussed. The salts can be removed from the water but there generally remains 5.5 cc. of O/liter. The action of this gas can be minimized by keeping the pH value above 10. On the oil side of the tube, corrosion is due to S and its gaseous derivatives and to salts and their acid derivatives. The enlargement of the distance and fractionating equipment has increased the use of the tubular condenser over the submerged coil. The high velocity of the cooling medium in the tubular condenser, 3.5-5 ft./sec., means vapor velocity of 50-90 ft./sec., which causes high erosion unless the design is right. Outlet-water temperature should be limited to 140° F. or lower. At 170° F. scaling followed by dezincification of admiralty metal tubes occurs. With water-outlet temperature of 135° F. and vapor-inlet of 600° F., salt water can be used successfully as the cooling medium. The choice of materials of construction is also thoroughly discussed. WAT (29)

Tensile Properties of Boiler Plate at High Temperatures (Festigkeitseigenschaften von Kesselblechen bei erhöhten Temperaturen). A. Pomp. *Stahl und Eisen,* Vol. 50, Dec. 11, 1930, pages 1737-1741.

The elastic limit, tensile strength, elongation and reduction in area of 12 boiler-plate steels have been determined at the ordinary temperature and at 300°-500° C., and the results are shown in tables and graphs. These indicate that there is a relation between the tensile strength at the ordinary temperature and the elastic limit at high temperatures up to 500° C. WAT (29)

On the Thermal Expansion of the Alloys of Iron, Nickel and Cobalt, and the Cause of the Small Expansibility of Alloys of the Invar Type. H. Masumoto. *Kinzoku no Kenkyu,* May 1931, pages 237-252; *Science Report, Tohoku University,* Series I, Vol. 20, 1931, pages 101-123.

The mean coefficient of thermal expansion between 30° and 100° has been determined for binary and ternary alloys of iron, nickel and cobalt. Generally speaking, the hexagonal solid solution has a greater, and the α solid solution a smaller coefficient of expansion than the γ solid solution. The expansion coefficient-concentration curve in the iron-nickel system has a maximum at a 25% Ni content and two minima at 18 and 36.5% Ni. In the iron-cobalt system, it has two breaks at about 79 and 95% Co content and an inconspicuous maximum at 35% Co, and in the nickel-cobalt system, it has a break at 70% Co. In the case of the ternary system of iron-nickel-cobalt, the minimum at 18% and the maximum at 25% Ni content found in the expansion coefficient-concentration curve of iron-nickel alloys, diminish first rapidly and then gradually with the addition of cobalt till they almost disappear at 40% Co content. The small coefficient of expansion of invar containing 36.5% Ni rapidly diminishes with an increasing content of cobalt in the alloy; it reaches a minimum at about 5% Co, and afterwards rapidly increases. For alloys having small expansibility, the measurement of thermal expansion was made from the liquid air temperature up to the vicinity of the critical point, and the available range of temperature for the small expansibility has been examined. The value of the smallest coefficient of expansion obtained here was less than 10^{-7}. An addition of a small content of manganese to the ternary alloys having a small expansibility lowers the Ar_3 transformation. A theory is proposed, by which the small expansibility of invar is satisfactorily explained from magnetic data, without assuming the existence of a compound Fe_2Ni or the A_3 transformation. The theory is as follows: the small expansibility depends upon the ferromagnetic state of the alloy, the paramagnetic state of the same alloy having greater expansibility. The mean coefficient of expansion of an alloy is shown by $\epsilon = \delta - \frac{\kappa I_\infty}{\Theta}$, where δ is the inclination of the paramagnetic part of the expansion-temperature curve, I_∞, the saturated magnetisation Θ, the temperature of A_2, κ, a constant. Iron-nickel concentration curve has a maximum of κI_∞ at about 40% Ni, and hence a minimum of ϵ at 36.5% Ni. If 5-6% Co is added the value of ϵ attains 10^{-7} or less. KT (29)

Designing High Temperature Steam Piping, Part I. Flexibility of 1000° F. Line. Arthur McCutchon. *Heating, Piping & Air Conditioning,* Vol. 3, Oct. 1931, pages 825-831.

An installation of a turbo-generator unit design to operate with steam at 1000° F. in the Delroy power house of the Detroit Edison Co. tests the theories of design quite as severely as it does the metals of which the unit is constructed. Engineering studies involved in the actual layout of this piping to provide for the movement due to expansion and a means of compensating for the effects of "creep" on certain of the flange joints have more than a nominal interest. The material used in this unit is the 18-8 type Cr-Ni steel, containing about 0.15% C. A chart is presented showing the linear expansion of this steel as compared with a medium carbon steel to temperatures of 1100° F. A distinct characteristic of this type of alloy is an unusually high coefficient of linear expansion. A similar chart is also given for the modulus of elasticity. The elastic modulus for the 18-8 steel decreased from 27 million lbs./in.^{2} at room temperature, to about 21 million at 1200° F. Calculations at 1000° F. used 21.6 million lbs./in.^{2} as a basis. The total allowable working stress, considering bending plus longitudinal pressure was placed at from 6,000 to 7,000 lbs./in.^{2} for the material used. The type of design employed to compensate for the linear expansion and "creep" will be discussed in Part 2 of this article to appear in the future. WAT (29)

Creep Determinations on Structural Steels at High Temperatures. *Metallurgist,* June 1931, pages 85-86.

An extended abstract of the work of Pohl, Scholz, & Juretzek, *Archiv für Eisenhüttenwesen,* Aug. 1930. See *Metals & Alloys,* Vol. 2, Feb. 1931, page 51. VVK (29)

REDUCTION METALLURGY (31)

Investigations on the Agglomeration of Siegerland Siderite by Coking with Coal (Untersuchungen über die Stückigmachung von Siegerländer Feinspat durch Verkoken mit Kohle). W. Luyken & E. Bierbrauer. *Archiv für Eisenhüttenwesen,* Vol. 4, May 1931, pages 505-511; *Stahl und Eisen,* Vol. 51, June 11, 1931, pages 739-740.

Report No. 27 of the Committee on Ores of the Verein deutscher Eisenhüttenleute. Siegerland siderite of various grain sizes was mixed with coal and coked in a small experimental furnace of 200 kg. capacity. The coal-iron ore mixtures contained 25%, 34% and 43% ore. Size and impact strength were determined. By dropping the coked product, having a grain size above 60 mm. 4 times from a height of 1.80 m., 90.8% of the coked product retained a grain size above 40 mm. when the amount of ore in the mixture amounted to 34%; 87.7% of the coked product had a grain size above 40 mm. when the amount of ore constituted 43% of the mixture. In coking the same coal without adding ore, an impact strength of only 80-85% is obtained. In adding ore, however, the loss of ammonia gas and benzol increases with increasing amount of ore. After these preliminary tests, tests on a large scale were made which showed the same favorable properties of the coked product. An essential advantage of this ore-coke is its high reactivity which amounts to 75-90% in comparison with 27-30% of the coke which does not contain ore. During the coking, up to 75% of the Fe content of the ore is transformed to metallic Fe. In spite of the previous unfavorable experience with Fe bearing coke in the blast furnace, its use seems to be favored by the above noted high reactivity. This new process seems to guarantee the economy of ore mining in the Siegerland ore mining district. GN (31)

Preliminary Tests on the Use of Coking Coals in Metallization of Iron Ores. W. R. McClelland. *Canada Department of Mines, Mines Branch Report* No. 720, 1931, pages 199-201.

A mixture of 24.36% magnetite and 19.12% hematite was successfully metallized by the Musso process using coking coals. Details of 3 tests are given. AHE (31)

New Process of Zinc Reduction. *Metal Industry,* London, Vol. 38, May 15, 1931, page 499.

Details are given of the experimental production of Zn by reduction of zinc oxide by methane. The information is taken from circulars issued by the Department of Commerce, Bureau of Mines, Washington. *Metals & Alloys,* Vol. 2, Aug. 1931, page 155. PRK (31)

Modern Installations of Blast Furnaces and Hot Blast Apparatus (Installations modernes de hauts fourneaux et d'appareils a vent chaud). *Revue Technique Luxembourgeoise,* Vol. 23, Sept.-Oct. 1931, pages 207-209.

Description and construction data of 3 new blast furnaces of 500 tons daily output and a volume of 867 m.^{3} Ha (31)

Oxidation from the Point of View of Heredity (Die Oxydation unter Berücksichtigung der Vererbung). *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 6, 1931, page 866.

Paper for the Scientific Committee of the Association Technique de Fonderie de Belgique at the Foundry Congress, Milan, Sept. 1931. The different behavior of chemically equal pig irons is traced to the influence of oxidation during the melting in the blast furnace. The conditions are not fully explained and require further investigation. Ha (31)

True Pyrite Smelting. Arthur J. Caddick. *Metal Industry,* London, Vol. 36, May 30, 1930, pages 577-578.

Usual amount of coke used varies with the class of ore treated, grade of matter required and furnace practice. Gives particulars of practice for 2 blast furnaces, each smelting 16,000 tons without the use of any carbonaceous fuel. This, according to the author constitutes a world record. Gives a record of the 2 furnaces. The success of the smelting operation depends upon a strict watch of ore mixture required at the time according to general condition of the furnaces and upon proper amount and pressure of blast. VSP (31)

Blast-Furnace Data and Their Correlation. Part 2. E. C. Evans, L. Reeve & M. A. Vernon. *Iron & Steel Institute, Advance Copy* No. 6, May 1931, 68 pages; *Iron & Coal Trades Review,* Vol. 122, May 8, 1931, pages 743-753; *Engineering,* Vol. 131, June 9, 1931, pages 807-810.

The mathematical expressions given by Evans and Bailey in Part 1 are modified slightly to agree with additional data. Operating results from over 220 furnaces are given and discussed. For an individual furnace, as the time of stock descent decreases the iron factor (pounds of C burnt to CO in hearth per ton of pig iron) increases, and the advantages gained by increasing the output over a certain amount are counterbalanced by increased hearth requirements. For optimum fuel consumption and output, the time of stock descent for rich burdens is less than that for poor burdens. Detailed records for one blast furnace are given and analyzed. 9 references. LFM+JLG+Ha (31)

The Flash Roasting of Iron Pyrites. Horace Freeman. *Chemical Age,* London, Vol. 25, Aug. 1, 1931, pages 111-112.

The pyrite preferred for the flash-roasting process is flotation pyrite dried down to 2-3% moisture content and containing about 50% S (dry basis). See *Metals & Alloys,* Vol. 2, Sept. 1931, page 194. (31)

Reduction of Lead Ore without Coke. (Brennstofflose Bleierzverhüttung.) N. C. Kyriacou. *Metall und Erz,* Vol. 28, Sept. 1931, pages 447-451.

Contains 16 references. Lead ore is roasted with sand and lime to burn out sulphur forming PbO and $PbSO_4$. $PbSO_4$ is then broken up with the formation of silicates. At the same time the material changes from powder to granular form. The roasting is done in a rotary furnace 40 m. long, taking about 2 hrs. Good results in reduction have been obtained by using anthracite powder instead of coke. 10 to 15% is added to a 2500 kg. charge of lead oxide. A hot fluid slag containing only 0.25 to 0.55% Pb is formed. The process is very economical and is much cheaper than the ordinary coke process. CEM (31)

MANUFACTURERS' LITERATURE REVIEWS

In this department we each month list the catalogs and other printed matter issued by manufacturers. Unless otherwise noted, any of the items listed may be secured free upon application to the issuing firm. Manufacturers who have not yet sent in their printed matter are invited to do so.

314 **Chrome Brick**—Bulletin 1-13-15 of E. J. Lavino & Co., Bullitt Bldg., Philadelphia, Pa., stresses the unusual chemical and refractory properties of chrome ores in the manufacture of refractories. Physical properties of brick made by their improved process are illustrated. Several of their pamphlets show the application of these bricks in basic open-hearth furnaces, in soaking pits and recovery furnaces.

315 **Blowers**—Bulletin No. 500-1 of the Northern Blower Co., W. 65th St., Cleveland, Ohio, is devoted to their continuous operating air filters, giving details of construction and operation.

316 **Bright Annealing**—A leaflet sent out by the Process Engineering & Equipment Corp., Attleboro, Mass., calls attention to their special atmosphere electric conveyor furnaces, installed to replace two fuel fired batch type furnaces and to eliminate pickling, cleaning and drying equipment. Another leaflet issued by the same company describes their furnaces for copper brazing.

317 **Air Tools**—Catalog AG-200 of the Madison-Kipp Corp., Madison, Wis., is devoted to their Air Chippers ,which may be used for swaging, riveting, scraping, wood chiseling, stone chipping, etc., and their Air Grinders. Grinding wheels, smoothing stones and buffing tips for use in this latter machine are illustrated. A price list is included.

318 **Special Alloys**—A leaflet issued by the Federated Metals Corp., 295 Madison Ave., New York, lists their special alloys, indicating their uses and compositions.

319 **Metal Testing Machinery**—Catalog 390 of Louis Schopper, sent out by Testing Machines, Inc., 314 Broadway, New York, illustrates measuring appliances for investigating the strength of materials. Machines for carrying out tests respecting tensile properties, compression, bending, etc., Ball hardness testers and pendulum impact testers are described.

320 **Hydraulic Tables**—Bulletin No. 25 of the Baldwin-Southwark Corp., Philadelphia, Pa., is a compilation of data of interest and value to those engaged in the design or use of hydraulic equipment.

321 **Cadmium Plating**—The January issue of the Udylite News, published by the Udylite Co., Detroit, Mich., contains a résumé of the articles that have appeared in the bulletin during the year 1931. There is also a description of an electric windshield defroster which is finished in Udylite.

322 **Hardening High Speed Steel**—Bulletin No. 1012-2 of the Sentry Company, Taunton, Mass., describes their Diamond Block method of hardening high speed steel. The bulletin is illustrated with micrographs. The same company has developed a non-metallic tray to be used in connection with this hardening method. High speed tools hardened by this method are said to retain their original surface free from scale, soft surfacing or carburization.

323 **Annealing Furnaces**—Leaflets describing their electric bell type annealing furnaces may be obtained from the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

324 **Die Castings**—An attractive booklet describing their aluminum die castings has been prepared by the Aluminum Company of America, Pittsburgh, Pa. The booklet is profusely illustrated.

325 **Steel Pipe and Tubes**—A 39-page bulletin issued by the National Tube Co., Pittsburgh, Pa., is devoted to their stainless and heat resisting pipe and tubes with particular reference to U S S 18-8 alloy tubular products. Extensive tables show their resistance to various chemicals and different sections of the booklet discuss their fabrication and metallurgical properties.

326 **Dehumidification of Air**—Special Development Bulletin No. 16 of the Dow Chemical Company, Midland, Mich., is a very thorough discussion of the dehumidification of air by calcium chloride. It contains data which is reliable and directly applicable to humidifier design.

327 **Fluxes**—A leaflet issued by Krembs & Co., 669 W. Ohio St., Chicago, Ill., lists their fluxes and indicates the use for which each kind is intended. Prices are included.

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ALPHABETICAL INDEX TO ADVERTISERS

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328 **Chain Drives**—The Link-Belt Co., 501 N. Holmes Ave., Indianapolis, Ind., has sent out a leaflet announcing their 3/16" pitch silent chain.

329 **Non-Ferrous Castings**—The Development and Research Department of the International Nickel Co., 67 Wall St., New York, N. Y., has recently issued a booklet entitled "The Use of Nickel in Non-Ferrous Castings." In this report the effect of nickel on the properties of brass and bronze is noted. Several useful tables are given showing typical compositions of nickel for various purposes. A list of special alloy compositions containing nickel, with their trade names is convenient for reference.

330 **Steel Foundry Phraseology**—The January issue of *Research Group News*, published by the Electric Steel Founders' Research Group, 541 Diversey Parkway, Chicago, Ill., features an article on steel foundry phraseology which includes a short glossary of foundry terms. The same issue contains an article entitled "First and Final Costs as Influenced by Design."

331 **Carburizing Furnaces**—A late bulletin of the Surface Combustion Corp., Toledo, Ohio, is devoted to their continuous gas carburizing furnaces and contains an article on one of their units installed by the Chrysler Corporation.

332 **Gas Producer**—Bulletin No. 45 of the Semet-Solvay Engineering Corp., 40 Rector St., New York, N. Y., is a very thorough discussion of their Koller type gas producer, and includes a cross section diagram of a typical installation.

333 **Carborundum**—The Carborundum Co., Niagara Falls, N. Y., has compiled a booklet containing full information on cemented tungsten carbide and its characteristics and a detailed explanation of the grinding process.

334 **Foundry Equipment**—The January issue of Better Methods published by the Beardsley & Piper Co., Chicago, Ill., describes an installation of one of their Sandslingers in the Spring City Foundry, Waukesha, Wis.

335 **Boilers**—Combustion Engineering Corp., 200 Madison Ave., New York, N. Y., has just issued a catalog describing the C-E VM type boiler. It is of the bent-tube type and is adapted to plants having limited space conditions.

336 **Lead-coated Copper**—Application of lead-coated copper to vertical surfaces and roofing is illustrated in the February issue of the Bulletin of the Copper & Brass Research Association, 25 Broadway, New York.

337 **The Laboratory**—The Vol. 5, No. 1, issue of this periodical of the Fisher Scientific Co., Pittsburgh, Pa., is a tribute to Justus von Liebig, pioneer in the design of chemical apparatus.

338 **Engineering Achievements, 1931**—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a collection of descriptions of their technical achievements during the past year, in steam generating plants, transmission, switchgear, transportation and the home.

346 **Illium**—An alloy developed by the Burgess-Parr Co., Moline, Ill., offers remarkable resistance to a great many corrosives. Its physical properties, fabrication and applications are discussed in an attractive booklet issued by the company. It is classed as a non-ferrous alloy composed of nickel, chromium, copper, molybdenum and tungsten with small amounts of iron, manganese, silicon and carbon.

GENERAL (0)

Textbook of Physical Chemistry (Lehrbuch der physikalischen Chemie). *Ferdinand Enke, Stuttgart.* **Vol. I. Basic Principles of Physical Chemistry. The Fluid State of Aggregation of Pure Substances.** 1928. 966 pages. Price 82 RM. **Vol. II. The Solid State of Aggregation of Pure Substances. Dilute Solutions.** 1928. 924 pages. Price 88 RM. **Vol. III. The Statistics of Chemical Reactions in Dilute Mixtures.** 1930. 893 pages. 92 RM. **Vol. IV, Part 1. The Statics of Chemical Reaction. Chemical Kinetics.** 1931. 288 pages. Price 26 RM. Paper, 6½ x 10 inches.

This work is still unfinished. The remaining parts of Vol. 4 and Vol. 5 will contain what might be called "atomic physics." The subjects treated are discussed with clearness and completeness. The viewpoint is inclusive rather than critical. The theoretical discussions are well handled. The experimental methods and apparatus described represent in many cases "classical" rather than modern procedure. For example, Kohlrausch's bridge for the conductivity of solutions is given in detail, but scant mention is made of modern alternating current bridges. In the main, only subjects concerned with "physical properties" and subjects amenable to mathematical theory are presented. The colloidal state of matter is not mentioned. The crystallography section is unusually large, but barely mentions the use of X-rays in this field. One very well known American writer is mentioned only in connection with work he did in Germany in 1894. Another equally prominent American physical chemist gets but little more mention. In applications of thermodynamics the situation is somewhat better. H. W. Russell (0) -B-

Journal of the (British) Institute of Metals, 1931, No. 2, Vol. 46. Institute of Metals, London, 1931. Cloth, 5½ x 8½ inches, 571 pages. Price 31 s. 6d.

This volume of proceedings contains the autumn lecture by U. R. Evans, on Thin Films in Relation to Corrosion Problems, in which he remarks that some people do not believe in thin films because they "will never accept a simple explanation if a complicated one can be suggested; it is possible to offer no help to persons of this mentality; indeed I am assailed by doubts as to whether they are worth helping."

He takes a crack at those who divide metallurgy into ferrous and non-ferrous by commenting, at one point, as follows: "These examples, however, have been taken from iron —a metal which this Institute does not officially recognize, although I cannot but think that some of the members in their private capacity may be dimly aware of its existence."

The other articles deal with oxidation of Cu alloys, protection of Mg alloys against corrosion, attack on steel in hot galvanizing, spectrographic analysis, wire drawing, brittleness of Cu, testing thin Cu strip, work-hardening of Cu, Brinell testing, cold-rolling and heat-treatment of Pb alloys, Duralumin, unsoundness in Al sand-castings, macro-etching of Al-Si alloys, failure of high strength brass, data on Cu Mg, Ni Cu, Au Cu and Ag Hg alloys, melting Ni Cr alloys in hydrogen and with electric furnaces for bright annealing.

As usual, the discussion adds materially to the value of the papers. H. W. Gillett (0)-B-

Effects of Mechanical Treatments on the Strength of Materials Used in Aviation. (Les effets des traitements mecaniques sur la resistance des materiaux employes dans l'aviation). E. Pretet. *Revue de Métallurgie,* Vol. 28, Dec. 1931, pages 661-672.

The final properties of the materials are pronouncedly affected by mechanical working in any stage of their manufacture. A certain amount of mechanical deformation is necessary for all metals, but it must be done correctly. JDG (0)

The World of Metallurgy. John A. Mathews (Crucible Steel Co. of America). *American Institute Mining & Metallurgical Engineers, Preprint,* 1931, 13 pages.

An address delivered at Columbia University, which defines the field of metallurgy and discusses progress in this field. See editorial comment, *Metals & Alloys,* Vol. 3, Feb. 1932, page 28. JLG (0)

The Economic Significance of Specifications for Materials. Value of Specifications in the Manufacture of Steel. John Brunner (Illinois Steel Co.). **The Economic Significance of Specifications from the Standpoint of a User of Steel.** P. Parke (Pullman Co.). **The Economic Significance of Specifications for Materials from the Point of View of a Producer of Concrete.** J. P. H. Perry (Turner Construction Co.). **The Use of Specifications for Concrete from the Point of view of the Consumer.** Arthur R. Lord (Lord & Holinger). **Specifications from the Standpoint of a Large Purchaser of Engineering and Special Materials.** J. W. Bancker (Western Electric Co.). *Journal Western Society of Engineers,* Vol. 36, Oct. 1931, pages 280-301.

A series of 5 papers, read at a joint meeting of the Society with the American Society for Testing Materials, covering the viewpoints of a producer and a consumer of concrete, a producer and a consumer of steel and a large user of other materials. 8 advantages of specifications to the producer or seller, 9 to the consumer or buyer and 5 to the purchasing organization are listed. 4 faults of ill-considered specifications are: (1) unnecessary limitations due to ignorance of the properties governing successful and economic use of the material, (2) ambiguity, resulting in continued controversy, (3) unnecessary incompatibility with standard or commercial practices and (4) inclusion of limitations which the supplier cannot reasonably be expected to meet since the origin of the variation is beyond his control. The trend in specification work continues to be toward simplification and standardization with more coöperative work between those interested. WHB (0)

Steel Metallurgy in 1930. G. R. Fitterer. *Blast Furnace & Steel Plant,* Vol. 19, Jan. 1931, pages 99-100.

Brief review on wrought iron, transportation of metal, rolling mills, open-hearth ports, open-hearth chemistry. Mn-Si deoxidizers, converters, electric furnaces and alloy steels. Ha (0)

Science in Action. E. R. Weidlein & W. A. Hamor. McGraw-Hill Book Company, New York, 1931. Cloth, 6 x 9¼ inches, 310 pages, 32 figures. Price $3.00.

A survey of scientific research as applied to American industries, written for the non-technical "business man" reader, and based upon the authors' experience in directing the work of Mellon Institute.

Such a wealth of material is available on the achievements of scientific research that any one subject is sketchily dealt with. Metallurgy is covered in about a dozen pages all told, and the great bulk of the comment refers to chemistry, largely organic chemistry.

Metallurgy, according to a table shown, leads in the number of separate laboratories studying the problems of a given group of industries, with 226, the runners-up being paints and varnishes, 177; pulp and paper, 166; foods, 155. 20 fields are mentioned, each of which is dealt with by 75 or more laboratories.

Beside the general historical statements which make up the bulk of the book, and which show the bearing research has had on the establishment of new industries and the rejuvenation of old ones, there are chapters on scientific management, on the management of industrial laboratories, and on the qualities needed in research workers.

Much of the book is re-written from more detailed articles and talks which were, in general, rather more effective in their original than in their present form. In the desire to make the book all-inclusive, only brief generalizations are given on the various topics, so that the style is very compressed and a bit cold-blooded. The romance and adventure of scientific research is evident, but so submerged that it seldom breaks through to the surface. Non-technical writers, Floyd Gibbons, for example, using the same material, would have produced a more lively volume. It would be interesting to know whether the restrained style of the authors carries more conviction to the businessman reader than a more flamboyant one. Scientific workers will prefer it as it is, and will find it an interesting record of achievements that they may hope to emulate.

The paper used in the book does not allow the illustrations to show up to full advantage. H. W. Gillett (0)-B-

Report of the Technical Director, U. S. Government Printing Office. B. L. Wehmhoff, pages 116-128. Annual Report of the Public Printer, 1931.

The tarnishing of bronze stamping leaf is chiefly governed by the protective coating on the leaf.

Linotype metal continued to be standardized at 11½% Sb, 4 to 4½% Sn, balance Pb. An alloy of 11½% Sb, 6½% Sn, balance Pb produces sharper type faces.

Monotype metal is standard at 16.8% Sb, 7.3% Sn, balance Pb. For large type and rules one of 19% Sb, 10% Sn, balance Pb was satisfactory.

Stereotype metal remains at 13% Sb, 6½% to 7% Sn, balance Pb.

Bismuth up to 4% is neither beneficial nor detrimental in stereotype metal. With 2% Bi the plates were slightly brighter, which facilitates examination of the type face for defects.

The International Association of Electrotypers has adopted 3½% Sb, 4% Sn, balance Pb as standard electrotype backing metal.

Nickel electrotyping is now done with a solution of 7 oz./gal. of double nickel salts instead of 3 oz./gal. Covering of the wax proceeds more rapidly, double the current density is used and the time is cut some 25 to 30%.

In copper electrotyping the use of phenolsulphonic acid as addition agent produced a 42% thicker deposit on the printing surface, after plating for the same time, as when glue was used.

No trouble was met with copper sheets for half-tone work, but zinc sheets used in line work have been unsatisfactory in some cases and this problem is being studied. H. W. Gillett (0) -B-

Coöperative Research in the Iron and Steel Industry. F. N. Speller. *Engineering,* Vol. 131, June 19, 1931, page 802.

Paper read before the American Iron & Steel Institute, May 1931. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 159. LFM (0)

Report of Technical Committees of the deutschen Gesellschaft für Metallkunde. (Mitteilungen der deutschen Gesellschaft für Metallkunde. Arbeiten der Fachausschüsse.) *Zeitschrift für Metallkunde,* Vol. 23, Sept. 1931, pages 266-268; Oct. 1931, pages 291-292.

Includes following reports: Spectroanalysis (Gerlach), Magnetism of Pure and Alloyed Noble Metals and Its Meaning for the Theory of Metals (Vogt), Thermoelectric Force in the System Au-Cu (Gerlach), Explanation of the Change in Susceptibility During Tensile Loading (Gerlach), Oxygen in Silver-copper Alloys (Raub). With discussion. RFM (0)

Magnetic Materials in the Year 1931. T. D. Yensen. *Yearbook American Iron & Steel Institute,* 1931, pages 452-485.

Includes discussion. The author reviews briefly the present theoretical views of the nature of ferro-magnetism and the effect of impurities; it is shown how the results from these considerations have led to the high-grade magnetic irons; their equilibrium diagrams are discussed. It is pointed out that the discrepancy between the theoretical curves for ferromagnetic materials and the early experimental curves were due to impurities and other factors which distort the crystal lattice. The development of methods of controlling these factors by means of new methods of analysis and new metallurgical processes it will be possible to produce magnetic materials to suit all requirements of practical application. 30 references. Ha (0)

The Constructor and the Science of Materials. (Konstrukteur und Werkstoffkunde.) A. Krauss. *Maschinenbau,* Vol. 10, Feb. 5, 1931, page 65.

The author makes some remarks concerning the unsuccessful use of material by the builder who does not take into consideration the possibility of residual strains in his structures. MAB (0)

The Theory of Metal Dissolution. II. III. (Zur Theorie der Metallauflösung.) M. STRAUMANIS (University of Riga). *Zeitschrift für physikalische Chemie,* Sec. A, Vol. 153, Feb. 1931, pages 107-111; Vol. 154, Sept. 1931, pages 150-158.

The difference effect cannot be interpreted as a mere resistance phenomenon. The author, therefore, stands by the theory previously developed (see *Metals & Alloys,* Vol. 2, Oct. 1931, pages 208, 217). The vectorial properties of the metal space lattice are responsible for the phenomenon discussed. The potential becomes nobler during the dissolution of metals. Part III. The author claims that the potential differences are not responsible for the anisotropic behavior of the metals in regard to their dissolution speed. Based on thermo-dynamic conclusions and on the theory of crystal growth, Straumanis concludes that the different surfaces of a metallic crystal display equal electro-chemical equilibrium potentials if the valence of the ions does not change. The differences in the dissolution velocities of the various crystal surfaces are ascribed to "included layers" of a regular arrangement which actually dominate the magnitude of the dissolution factors as the number of the elements/cm.^{2}, their resistance and the over-voltage of the cathode. EF (1)

Permanent Electric and Magnetic Moments of Crystals. F. ZWICKY. *Physical Review,* Vol. 38, Nov. 1931, pages 1772-1781.

The conditions for the existence of self-perpetuating electric moments in crystals are discussed. If these conditions are satisfied, the crystals must either show macroscopic electric moments or they will necessarily possess a definite type of a secondary structure. Certain complications, however, come in if one is dealing with metals. Experimental investigations on single crystals suggest that there are secondary lattices of very different types. Ferromagnetic crystals behave abnormally in regard to plastic deformation. Single crystals ordinarily glide along certain planes belonging to a discrete crystallographically determined set. In Fe, however, only the (111) direction is distinguished, but any plane through it may be a slip plane. This becomes comprehensible if one considers that the elementary parts of the magnetic secondary structure of iron are slightly tetragonal. Adjacent blocks are in phase only for distances less than 200A.U. making use of Bitter's estimate. Fe is therefore, in a way, more similar to an amorphous substance than to other metal crystals whose secondary structures are characterized by spacings of the order of 1μ. It is to be hoped that if Fe single crystals are annealed and distorted in a magnetic field that they also will exhibit definite crystallographic slip planes. Experiments to check this are being carried out. WAT (1)

Determination of the Melting Point of Platinum (Détermination de la température de fusion du platine). G. RIBAUD & P. MOHR. *L'Industrie électrique,* Vol. 40, Mar. 10, 1931, page 113.

By means of optic extrapolation, from the melting point of Au, the melting point of Pt was found to be at 1762° C. = 2305° K. with an error of ± 2°. Ha (1)

Silver and Its Application to Chemical Plant. DONALD McDONALD. *Journal Society Chemical Industry,* Vol. 50, Feb. 27, 1931, pages 168-178.

A very excellent review covering Ag's economic history, occurrence and metallurgy, physical and chemical properties, alloys and applications. VVK (1)

Tantalum and Niobium—Costly Metals With Growing Uses. *Chemical Trade Journal,* Vol. 88, Jan. 23, 1931, pages 77-78.

A monograph on the Mineral Industry of the British Empire and Foreign Countries dealing with Ta and Cb has been issued. Tantalite and columbite are the most prominent minerals. Methods of producing metallic Ta and Cb and the physical and chemical properties are discussed. Ta forms alloys with a number of metals including Fe, Mo and W, ferro-tantalum containing 60-70% Ta, alloys of Pt and Ta containing up to 20% Ta are highly resistant to acids or aqua regia and are harder, and less expensive, than Pt. The uses of Cb are being investigated. WHB (1)

Anisotropy in Zinc Plates. (Ueber die Anisotropie von Zinkblechen.) E. SCHMID & G. WASSERMAN. *Zeitschrift für Metallkunde,* Vol. 23, Mar. 1931, pages 87-90; *Mitteilungen der deutschen Materialprüfungsanstalten,* Sonderheft 17, 1931, pages 20-24.

The anisotropy of the yield point (0.02% and 0.20%), tensile strength, elongation, elastic modulus, thermal expansion, and specific electrical resistance in rolled Zn plates was studied. Graphs and tables record the experimental results obtained from measurements taken parallel and perpendicular to the direction of rolling (except for specific electrical resistance for which no appreciable difference could be found). The results are correlated with the rolling textures (preferred orientations) previously observed and with similar data obtained from studies on single crystals. The rolling texture of Zn is inhomogeneous. Upon the plate surface the texture is a simple fiber structure with the hexagonal axis in the direction of the plate normal. This superficial texture does not contribute to the anisotropy of the plates but diminishes it. The scattering in this orientation is considerable, reaching as high as 80°. RFM+EF (1)

Tin: Its Major Uses. *Tin,* Feb. 1931, pages 14-18.

Pointing out the importance Sn has assumed in present-day life, some commercial uses are discussed and the numerous alloys enumerated as to their analyses, applications and properties. The complete specifications of the British Engineering Standards Association for industrial uses are reproduced, and the compositions used for type metals are given. In all, 25 different alloys are treated. Ha (1)

Impurities. *Metallurgist,* Oct. 1931, pages 145-146.

Very pure metals possess quite different properties than commercially pure metals. The commercial purity of metals has been steadily increasing. Chemical methods of determining traces of impurities have not kept pace with the increased purity of metals. Spectroscopy will probably solve this difficulty. Many examples are given. VVK (1)

Gmelin's Handbuch der anorganischen Chemie. Eisen. 8th Edition. Verlag Chemie G.m.b.H., Berlin, 1931. Paper 7x10 inches, pages 657-872. Price 35 RM.

The fourth section of Part B continues the survey of the iron compounds. In the first part of this section, the Fe-C compounds are completed in dealing with iron cyanides and the balance is devoted to compounds of Fe-Si, Fe-P, Fe-Sb, and Fe-Bi. In the chapter dealing with the iron silicates, it will be of interest to note that even the FeO-SiO^2 system as it has been established by C. H. Herty and G. R. Fitterer's investigations is included. There is no need to point out that this latest section of the volume on Fe of the Gmelin series is of similar excellence to those previously published and reviewed in *Metals & Alloys,* Vol. 1, Dec. 1930, page 918; Vol. 2, Oct. 1931, page 207. G. Neuendorff (1) -B-

Effect of Impurities on Ferromagnetization. T. D. YENSEN. *Physical Review,* Vol. 38, Jan. 1932, pages 358-363.

The paper is one of the Symposium on Magnetization of the American Physical Society, Sept. 1931. The type of impurities discussed herein are those which do not fall in the ranks of the iron atoms, yet which to some extent become entangled in the iron lattice. These impurities have been studied with regard to the magnetic properties of iron in an effort to determine the magnetic properties of very pure iron. While the effect of small amounts of impurities on the saturation value is small, their effect on the initial and maximum permeabilities and on the coercive force and hysteresis loss is very great. WAT (1)

High Conductivity Oxygen-Free Copper. U. S. Metals Refining Company Booklet, Jan. 2, 1932, 10 pages.

Brief discussion of oxygen-free copper, now available as wire bars, cakes, and round billets for tubes, cast on end in water-cooled molds, and cropped. The material is specified to be free from cuprous oxide, as determined by the microscope, and is said to contain no residual deoxidant, meeting A.S.T.M. Specification B5-27. No information is given as to the process of manufacture.

The copper pipes on solidification, and so the castings are cropped instead of being brought to a level set. It is supplied in two brands, OFHC (oxygen-free high conductivity), and in the same, "selected," i.e., each bar tested to Bell Telephone Specification for submarine cable, which includes a hydrogen anneal for ½ hr. at 850° C.

Comparative tests on 0.081" diameter wire drawn from 5/16" hot-rolled rod show:

	Conductivity %		No. of 90° Bends Over 5 mm. Radius			No. of Twists in 6" Test Length			Reduction of Area %	
	Hard	Soft	Hard	Soft	H_2 Ann.	Hard	Soft	H_2 Ann.	Hard	Soft
Av. Electrolytic	98.77	101.14	6.9	13.0	0	72	89	0	55	76
Oxygen-free	98.07	100.63	10.4	18.3	10.4	130	16.3	147	80	88

No explanation is given for the lower conductivity of the oxygen-free copper.

On comparative tube drawing the OFHC copper stood 6 draws without annealing to a total cold drawing of 94% while phosphorized copper required annealing after the third draw, or 59%.

It is claimed that this copper offers more resistance to fatigue than ordinary electrolytic copper. H. W. Gillett (1)

Transformation Phenomena in the So-Called Semi-Conductors. (Umwandlungserscheinungen an sogenannten Halbleitern.) A. SCHULZE. *Zeitschrift für Metallkunde,* Vol. 23, Sept. 1931, pages 261-264.

Investigation shows that the transformation phenomena in these elements (Si, Ge, Ti, Zr) are quite different from previous conceptions. The behavior of these elements with respect to electrical conductivity and its temperature coefficient is fundamentally affected by surface layers. If these layers are not present the observed behavior is metallic. Measurements of electrical conductivity and thermal expansion in polycrystalline and monocrystalline Si, show the absence of transitions. This is confirmed by determinations of lattice structure. Ge shows a similar behavior with respect to electrical resistance. The electrical behavior of Ti indicates it to be without transformation points. The irregularities in the behavior of commercial Ti above 500° C. can be explained only on the basis of impurities. Zr shows a transformation point above 800° C. The transformation characteristics of these elements must be studied with the element in a form in which the disturbing effect of intercrystalline layers is avoided. RFM (1)

Changes of the Electromotive Force of Zinc with the Thermal Treatment. (Ueber die Aenderung der EK des Zinks bei thermischer Bearbeitung.) A. SCHÜKAREW & L. WERESCHTHAGIN (College of Charkow). *Physikalische Zeitschrift,* Vol. 32, Mar. 1, 1931, page 230.

A curve is presented revealing the successive changes of e.m.f. of a zinc test piece during an extended exposure to 200° C. There are material fluctuations with time, but the curve obtained does not correspond to a simple relationship. EF (1)

Rare Metal Thallium is Finding New Uses. *Steel,* Vol. 89, Aug. 20, 1931, page 38.

Physical and chemical properties of Tl are similar to Pb; alloys of these 2 metals, contrary to other alloys, have a higher melting point than either of the components. A Tl-Sn-Pb alloy is resistant to H_2SO_4, HNO_3 and HCl. It is used also for optical glasses with a high refractive index, and in light sensitive cells. Ha (1)

Molybdenum, the Metal That Talks. *Industry & Welding,* Vol. 3, Jan. 1932, pages 6-9, 11.

History, discovery, properties of Mo and its particular advantages in steel making and its use in radio tubes are briefly described. Ha (1)

Preparation of Pure Cerium. (La préparation du cerium pur.) *Journal du Four Electrique,* Vol. 40, Dec. 1931, page 483.

A very brief review of older methods of preparation and the description of the method used by Billy and Trombe, *Comptes Rendus,* Sept. 7, 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 297. JDG (1)

On Adsorption (Ueber Adsorption). H. SCHLÜTER (University of Münster). *Zeitschrift für physikalische Chemie,* Sect. A, Vol. 153, Feb. 1931, pages 68-82.

The adsorption phenomena on silver and glass were studied in relation to temperature and pressure. EF (1)

Naval or Tobin Bronze Sheet. *Metal Stampings,* Vol. 4, Nov. 1931, page 906.

The weights/ft.^{2} from 2 ins. thickness down to gage 46 (0.0015 in.) are tabulated. Ha (2)

Tests of Zinc-Alloy Die-Cast Gears. *Metal Industry,* N. Y., Vol. 29, Mar. 1931, page 121.

Digest of paper by Robert M. Curts (New Jersey Zinc Co.) read before the Society of Automotive Engineers, Jan. 1931. Investigations showed that die-cast zinc-alloy gears are superior to brass or steel gears if not lubricated, but inferior to brass or cast iron gears if thoroughly lubricated with light mineral oil and inferior to brass gears if lubricant contains acid animal fat. The die-cast zinc-alloy gears broke under a load of 3461 lbs./in.^{2} of face as compared to 1996 lbs./in.^{2} of face for cast iron. PRK (2)

A New Beryllium Alloy. *Product Engineering,* Vol. 3, Feb. 1932, page 56.

The effect of Be in various amounts on Cu is described; an addition of 2 to 2.5% Be gives a tensile strength of more than 200,000 lbs./in.^{2} with a Brinell hardness above 400. An addition of only 1.25% Be gives a great resistance to abrasion; this percentage is also the lowest that will permit heat treatment. All Cu-Be alloys have a crystalline structure very suitable for bearing metals; tests made on bearings for German railways, indicated antifriction and wearing qualities superior to those of Sn bronzes. Physical properties for some more alloys are given. Although Cu-Be alloys at present are more expensive than Cu-Sn bronzes, their superior physical properties will make them economical for parts where corrosion resistance, wear resistance and high strength are important. Ha (2)

K. S. Seewasser, a Rustless Light Alloy. Correspondence from E. W. Ehn, Schweinfurt, Germany. *Metal Progress,* Vol. 20, Dec. 1931, pages 82-83.

The writer reports the resistance to corrosion and physical properties of an aluminum alloy with 1.4% Mn, 2.0% Mg, 0.2% Sb, and 0.7% Si. WLC (2)

Monel Metal and Nickel Alloys. T. H. Wickenden. *Paper* before the *Conference on Metals & Alloys,* Case School of Applied Science, Cleveland, Nov. 1931, 1 page. Mimeographed.

Brief historical data on Ni and Ni-Cu alloys are given and the fields of application are enumerated. Ha (2)

Use of Bismuth in Metal Forming. Walter C. Smith (Cerro de Pasco Copper Co.) *Metals & Alloys,* Vol. 2, Oct. 1931, pages 237-239.

The author discusses the composition of low melting point alloys. Use for bending copper tubing and for mounting die assemblies is described. Properties of common low melting point alloys are given with those of a new alloy, Matrix alloy, for mount dies which contains Bi 50.0%, Pb 26.7%, Sn 13.3%, Cd 10.0% and has a freezing point of 158° F. WLC (2)

Hydrogenation Activity, Magnitude and Structure of Nickel Surfaces. The Topo-Chemistry of the Contact Catalysis. V. (Hydrierungsaktivität, Grösse und Struktur von Nickeloberflächen. Zur Topochemie der Kontaktanalyse V). G. M. Schwab & L. Rudolph (Bayrische Akademie der Wissenschaften, München). *Zeitschrift für physikalische Chemie,* Sect. B, Vol. XII, June 1931, pages 427-448.

The specific catalytic action of various Ni-powders and their specific surfaces (initial dissolution speed in HCl) were determined. With reference to the hydrogenation activity, the authors conclude that the centers most active during the hydrogenation process must be chiefly sought at the corners and edges of the crystals. EF (2)

Zinc and Its Alloys. W. M. Peirce. *Conference on Metals & Alloys,* Case School of Applied Science, Cleveland, Ohio, Nov. 1931, Paper No. 9, 5 pages.

General discussion of uses for zinc, with special attention to die castings. See *Metals & Alloys,* Vol. 1, June 1930, page 544. HWG + Ha (2)

The Effects of Cold-Rolling and of Heat Treatment on Some Lead Alloys. H. Waterhouse & R. Willows. *Engineer,* Vol. 152, Sept. 25, 1931, page 330.

Abstract of paper read before the Institute of Metals, Zurich, Switzerland, Sept. 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 2. LFM (2)

Measurement of Sound Velocities of Substances in the Solid and Liquid State. (Messung der Schallgeschwindigkeit von Stoffen im festen und geschmolzenen Zustand.) M. Reich & O. Stierstadt (University of Göttingen). *Physikalische Zeitschrift,* Vol. 32, Feb. 1, 1931, pages 124-130.

A direction finder was developed for measuring sound velocities. Due to a peculiar shape of the test specimen, the disturbances produced by the reflection of the sound waves were eliminated. Thus for the first time a method was found how to measure sound speeds and compressibilities in melts at elevated temperatures. The changes in sound velocities were determined for the following materials: water-ice, Hg, Pb, Cd, Sn and Bi. With the exception of the last metal, the sound velocities in the solid phase proved to be twice the velocity in the liquid state. In conclusion analogies to the thermal and electric conductivities are pointed out. EF (2)

Measurement of Sound Velocities of Substances in the Solid and Liquid State. (Messung der Schallgeschwindigkeit von Stoffen im festen und geschmolzenen Zustand.) O. Stierstadt (University of Göttingen) *Physikalische Zeitschrift,* Vol. 32, Apr. 15, 1931, pages 346-348.

The previously described testing method (see abstract above) was employed for determining sound velocity in the liquid and solid state on thermodynamic grounds for Cd, Hg, Pb, Sn and Bi. The data obtained are compared with the changes of electrical conductivity at the melting point and theoretical conclusions are made in regard to the compressibility and modulus of elasticity. The sound speed is regarded as related to the energy content of the metal. EF (2)

Studies on Die Castings Lead to Standard Specifications. *Iron Age,* Vol. 126, Aug. 21, 1930, pages 492-494.

Taken from report of Committee B-6 of the A.S.T.M. 21 alloys cast by 6 producers are being studied. A minor impurity in ingot metal going into Zn-base alloys has a disproportionate effect on permanence of resulting die casting. Warm, moist air, with traces of sea salt, sulphur smoke or volatile trade wastes are particularly detrimental to Zn-base die castings. Some minor dimensional changes are due to a slow alteration in microstructure of the alloys. In pure Al-Zn alloys, the β-phase in eutectic transforms into another phase when heated through 270° C. with decrease of volume and evolution of heat. Western Electric Co. and Packard Motor Co. specifications call for Zn 0.02% maximum impurities and finished castings having less than 0.005% Pb, Sn or Cd. Includes table giving the chemical compositions of Al-base die castings, also photomicrographs. VSP (2)

Aluminium-Silicon-Magnesium Casting Alloys. *Metallurgist,* Jan. 1931, pages 6-8.

An extended abstract of the paper by R. S. Archer and L. W. Kempf on the subject published as *Technical Publication* No. 352, *American Institute Mining & Metallurgical Engineers.* See *Metals & Alloys,* Vol. 1, Dec. 1930, page 898. VVK (2)

Brass Die Casting Process. *Brass World,* Vol. 27, June 1931, page 127.

Pressing die castings of brass are now manufactured in commercial quantities by the Doehler Die Casting Co. The molten metal is forced into metallic dies in a manner similar to that of making pressure die castings in Zn, Al, Sn, and Pb base alloys. Fine-grain structure and very few imperfections are claimed. Inserts of other materials required to meet specifications or unusual applications can be cast in just as in the die casting of other alloys. Physical characteristics of the alloy are: tensile strength (ultimate), 65,000-70,000 lbs./in.^{2}; yield point, 35,000-45,000; elastic limit, 20,000-30,000; elongation, 15-20% in 2 in.; reduction area, 10-20%; Brinell hardness (500 kg.), 130-140; weight/in.^{2}, 0.303 lbs.; impact strength (Izod), 20-40 ft. lbs. WHB (2)

Effects of Strain and Heat Treatment on Properties of Copper Alloys. W. C. Ellis & E. E. Schumacher. *Fuels & Furnaces,* Vol. 9, Mar. 1931, pages 289-290.

Hard drawing subsequent to heat treatment materially increases the strength without appreciably increasing the resistivity of Cu alloys containing either Ni and Si or Co and Si. Cu-Ni-Si alloys attained a maximum strength of 140,000-150,000 lbs./in.^{2} with a conductivity of 30-33% of annealed Cu. Cu-Co-Si alloys had a strength of 85,000 lbs./in.^{2} and about 50% conductivity. By heat-treating between 300° and 500° C., these properties could be further influenced. See also *Metals & Alloys,* Vol. 2, July 1931, page 126. Ha (2)

Magnetic Susceptibility of Some Binary Alloys. Francis L. Meara. *Physics,* Vol. 2, Jan. 1932, pages 33-41.

The magnetic susceptibilities of 8 series of alloys: Sn-Tl, Sb-Tl, Tl-Cd, Zn-Cd, Pb-Sb, Sn-Sb, Cd-Sb and Zn-Sb have been investigated by Gouy's method. In three series, Sb-Cd, Sb-Zn and Sn-Sb an intermetallic compound is indicated by an abrupt change in the slope of the susceptibility concentration curve. The compounds thus indicated are Sn-Sb, Cd-Sb and Zn-Sb with some evidence for the compound Sn_2Tl. There is a linear relation between the susceptibility and concentration of one of the constituents where the constituents form simple heterogeneous mixtures—a result best illustrated in the Sb-Zn series of alloys. The curve showing the magnetic susceptibility of Sn as a function of the concentration of Tl by weight is composed of two curved portions with a sharp cusp at 42% of Tl. This cusp corresponds to the eutectic of the freezing curve. With the addition of Sb to Tl it is evident that the diamagnetic susceptibility of this series of alloys decreases, passes through a minimum at about 20% by weight of Sb and then increases steadily up to a large volume of Sb. On the addition of Tl to Cd the diamagnetic susceptibility increases continuously until pure Tl is reached. There is no evidence of an abrupt change of curvature in the curve at any concentration. The addition of Zn to Cd decreases the diamagnetic susceptibility rapidly until the concentration of Cd reaches 13% by weight. In like manner the addition of Zn to Cd rapidly decreases the diamagnetic susceptibility until the alloy contains about 10% of Zn. In the Pb-Sb series the susceptibility decreases with the addition of Pb until the alloy contains about 40% Pb. For higher concentrations of Pb there is nearly a linear relation between the susceptibility and the concentration. In the Sn-Sb series between O and 51% by weight of Sb the magnetic susceptibility is a linear function of the concentration, indicating a mechanical mixture over the range. An abrupt change in the slope at 51% by weight of Sb indicates the existence of the compound SnSb. There is a peculiar rise in the curve between 85 and 95% Sb. This rise is likely due to crystallization. In the Cd-Sb series the susceptibility shows a cusp at 51% Sb corresponding to the compound CdSb. The susceptibility curve for the Zn-Sb series is characteristic of a series in which one intermetallic compound is formed and this compound forms mechanical mixture with both of the pure metals entering into the alloy. This compound is formed at 35% Zn. WAT (2)

Highly Magnetic Alloys of Nickel-Iron (Hochmagnetische Legierungen aus Nickel-Eisen). Geo. Keinath. *Archiv für Technisches Messen,* section Z913-1, 1931, page T63.

The highly magnetic alloys are distinguished from the ordinary magnetic material by their high initial permeability, high maximum permeability, and constant permeability. The best known types are: Permalloy, 78.5% Ni, 21.5% Fe; a thermically less sensitive modification is 78.5% Ni, 18% Fe, 3.5% Mo. Hipernik, 50% Ni, 50% Fe, maximum permeability 167,000. Mumetal, Phometal, Megaperm, Permenorm, Perminvar are others of more or less similar composition, the heat treatment of which is of great importance in maintaining constancy of the good magnetic qualities. Curves for coercive power, maximum magnetizability, specific resistance and magnetic losses for alternating current are given. The influence of mechanical stresses is discussed. Ha (2)

Characteristics of Alloyed Cast Iron. F. W. Shipley. *S. A. E. Preprint*, 1931, 20 pages.
The research described was undertaken for the purpose of determining some of the qualities which might be obtained in cast iron through the use of alloys. It was found that increased quality (which was reflected through higher valve-seat hardness) and improved microstructure could be obtained by additions of Ni and Cr to automotive type cylinder iron. Different combinations of these alloys were used and it was found that a ratio of 3 parts of Ni to one part of Cr gave the greatest improvement in structure in conjunction with maximum hardness. The effect of prolonged heating on 3 representative plain irons as well as on 3 Ni-Cr alloyed irons of the same base composition is shown and a marked difference is revealed in favor of the alloyed irons. See also *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 31. WAT (3)

Nickel Alloy Steel Castings. A. G. Zima. *Steel Founder*, Vol. 2, Jan.-Feb. 1932, pages 6-17, 23.
The excellent physical properties of Ni steel castings as shown by ordinary static tensile tests are enhanced by the remarkable dynamic properties, i.e., resistance to impact and fatigue stresses. The properties of various alloys, as Ni, Cr, Mn, Mo, V, their effects, welding practice, method of adding the alloying elements, heat treatment, importance of proper design of castings and the miscellaneous applications are explained and the most important numerical values for all alloys given. Ha (3)

"Migra" Iron, A new Special Pig-Iron for High-Quality Castings. E. Piwowarsky & A. Wirtz. *Foundry Trade Journal*, Vol. 45, Oct. 22, 1931, pages 251, 252 and 254.
Translation of an article from *Die Giesserei* (1931, No. 36). See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA3. OWE (3)

Chromium-Nickel Steel Sheet and Strip. *Iron & Coal Trades Review*, Vol. 124, Jan. 1, 1932, page 5.
Brief data on the new specifications of the Air-Ministry of Great Britain for steels, D. T. D. 166, D. T. D. 171, D. T. D. 176. Ha (3)

Corrosion-Resisting Surface on New Composite Metal. *Steel*, Vol. 89, Aug. 20, 1931, pages 34-36.
A substitute for the expensive high-Cr, high-Ni steel alloys has been developed by the Industrial Welded Alloys, Inc. It is a composite metal, Plykrome, in which a corrosion-resisting steel is veneered and completely weld-bonded to a mild steel slab, and then rolled on a mill to form an integral plate or sheet. The method of doing it and applications are described. Ha (3)

Growth of Cast Iron Under Tensile Stress. Eugene Piwowarsky & Otto Bornhofen. *Foundry Trade Journal*, Vol. 45, Nov. 12, 1931, page 306.
An extended abstract of a paper on experiments which were carried out with a series of six different materials. See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA31. OWE (3)

Mechanical Properties of Malleable Iron on Various Sized Test-Bars. A. L. Norbury. *Foundry Trade Journal*, Vol. 45, Sept. 17, 1931, pages 175-179, 182; Oct. 1, 1931, pages 205-208; *Giesserei-Zeitung*, Vol. 18, Nov. 1931, page 868.
A paper presented to the Pan-European Foundry Congress containing an account of transverse, tensile, bend, and elongation tests carried out on round and oblong test pieces of various sizes of blackheart malleable and of whiteheart malleable after one, two, and three annealings and with increased Mn content. Photomicrographs of the ¼-inch and ½-inch round bars from edge to centre are shown for each of the above types of malleable. The variations in mechanical properties with size of test bar are related to the microstructure. In the case of blackheart, as the size of test bar increases, the transverse strength increases very considerably while the deflection decreases. In the case of whiteheart, as the size of test bar increases, the transverse strength increases and later decreases, while the deflection progressively decreases. With increase in number of anneals the ductility of whiteheart progressively increases. The strength varies in a complicated manner, increasing on certain sizes of test bar and decreasing on others. Increase in the Mn content of whiteheart from 0.08 to 0.56% has a remarkable effect in increasing the strength and ductility of all save the smallest bars. Round bars generally give better strength and ductility figures than oblong bars of similar size. The question of standard test bars is discussed. The article is accompanied by 15 photomicrographs, 25 diagrams, and 6 tables. Ha+OWE (3)

Patina Steel. *Engineering*, Vol. 131, Feb. 6, 1931, page 191.
Briefly describes properties of steel developed by Vereinigte Stahlwerke, A.-G., of Düsseldorf, Germany. It contains 0.2-0.3% Cu and bears the trade name Patina steel. A figure is given comparing its loss in weight after immersion for 40 days in H_2SO_4 and in citric acid with the loss sustained by ordinary steel. The loss in weight for Patina steel was 15% in H_2SO_4 and 12% in citric acid compared with 47% for ordinary steel. Its mechanical properties are the same as for ordinary steel provided the Cu content does not exceed 0.5%. It can be used successfully for riveting, welding, and galvanizing. Its exact composition is not given. LFM (3)

Valves and Valve Steels and their Heat Treatment. E. F. Davis. *Fuels & Furnaces*, Vol. 9, Oct. 1931, pages 1135-1142.
Above all, the construction of valves must possess strength and lightness; exhaust valves must have resistance to scaling, corrosion and burning, ability to withstand temperatures up to 1600° F. and repeated heatings and coolings without becoming soft or brittle. Intake valves are not subjected to the severe conditions of exhaust valves. Various grades of steel are discussed and the analyses of products of several companies are given. Formerly, they usually contained 0.5-0.7% C, 0.9-1.1% Cr, 1.0-1.5% W; today the W content is as high as 16% and the steels usually have a rather complex composition. The heat treatment, hardening, quenching and drawing temperatures of several steels are indicated. Ha (3)

The Manufacture and Properties of Malleable Iron Castings. *Foundry Trade Journal*, Vol. 45, Sept. 3, 1931, pages 143-144; Sept. 10, 1931, pages 160-161.
A report of a symposium on malleable iron castings, organized by the A.F.A. and A.S.T.M., which has been abstracted elsewhere in this journal. OWE (3)

Some Physical Properties of High Speed Steel. J. V. Emmons. *Transactions American Society for Steel Treating*, Vol. 19, Feb. 1932, pages 289-332.
Includes discussion. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 3. WLC (3)

Hardening and Tempering of Cast Iron. Results of Investigations and Recent Applications (Härten und Anlassen von Gusseisen. Untersuchungsergebnisse und neuzeitliche Anwendung). R. Chavy. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, page 867.
The hardening of martensitic and austenitic cast iron has been developed, until recently, very successfully by special addition elements, particularly Ni. Several types of castings change their structure by hardening, namely hard castings with martensite-cementite structure and the following types of gray iron: (1) pearlitic castings and sorbitic castings; (2) martensitic castings; (3) gray iron with austenite-martensite structure; (4) gray iron with pure austenitic structure. Ha (3)

18-8, New Facts and New Uses. *Metal Progress*, Vol. 20, Oct. 1931, pages 43-47.
Findings of several studies reported before the Boston Convention of A. S. S. T. are discussed briefly. Applications of the alloy to turbine blades, wire products and the effect of added elements are discussed. WLC (3)

Bending Strength, Deflection and Graphite Precipitation. (Biegefestigkeit, Durchbiegung und Graphitausscheidung.) F. Brinckmann. *Die Giesserei*, Vol. 18, Dec. 18, 1931, pages 929-931.
In order to classify cast-iron the measurement of the deflection at a constant load below fracture is proposed; this "specific deflection" is shown to have a direct relation to the elasticity coefficient and to make possible a conclusion on the behavior of the material in the range of its practically occurring stresses. In connection with the nature of graphite in the Fe also the tensile strength can be related to the specific deflection. The method is explained more in detail by the field diagram of Thum and the diagram of isoflexes of Meyersberg. Ha (3)

Specifications of Hardness for Machine-Casting. (Ueber Härtevorschriften bei Maschinenguss.) F. Brinckmann & A. Nehmitz. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 27, 1931, pages 889-892.
An investigation of the tolerances laid down in the Russian specifications for machine-cast parts of machine tools showed that the differences due to different testing methods were even greater than the tolerances permitted. The conditions are discussed and it is proposed to abandon absolute figures and permit a certain leeway from an average value determined by a large number of measurements. 7 references. Ha (3)

Physical Properties of Cast Iron Rolls (Festigkeitseigenschaften gusseiserner Walzen). E. Scharffenberg. *Stahl und Eisen*, Vol. 51, Oct. 8, 1931, pages 1249-1256.
In testing cast iron, the test bars are seldom taken from the castings but are cast as special bars during the casting of the article. It is obvious that the entirely different cooling conditions between a thin test bar and such a large mass as a rolling mill roll do not allow a proper judgment of the physical properties of rolls. It, therefore, seems necessary to determine the properties of rolls direct. The properties of cast iron rolls are not uniform throughout due to the effect of the ferro-static pressure. The graphite and the structure is finer in the lower parts of the casting and, therefore, the tensile strength and hardness are higher than in the upper parts. The results on physical tests of sheet rolls are tabulated. The graphite content of the top neck was, in all cases, on the average, 0.69% higher than the graphite content of the body. The variations of the physical properties are not clearly indicated by bending strength and tensile strength but are better shown in the figures on hardness. To the same extent, the variations of the properties between the bottom neck and the body were studied and it is shown that the properties of the neck are superior to the body. Physical tests at elevated temperatures were performed to give some indications as to the behavior of the rolls at the actual rolling temperatures. In determining the hot tensile strength of a cast iron roll with passes, the tensile strength was practically constant up to 600° C., with a sharp decrease between 600° C. and 800° C. Other tests were made on necks and body of broken rolls. It is remarkable that the top neck has a much lower tensile strength than body and bottom neck and that the tensile strength decreases between 200° and 400° C. but then increases again to attain a maximum at 600° C. In testing the various sections of the body, the tensile strength-temperature curves correspond to each other with a maximum at 500° C. Relations have been established between physical properties and grain size of the rolls; the tensile strength increases with decreasing grain size. Tests on chilled iron rolls indicate that a definite relation exists between hardness of the chill and bending strength of the matrix; the bending strength decreases with increasing hardness of the chill. In determining hardness and tensile strength of plain cast iron rolls, every type of roll shows a characteristic maximum value of hardness and tensile strength. A comparison of the tensile strength of cast iron rolls with that of test bars cast separately from the same heat, indicate that no relation exists between them. GN (3)

The Properties of Stainless Steels and their Further Treatment (Die Eigenschaften der rostfreien Stähle und ihre Verarbeitung). P. Wiessner. *Dinglers Polytechnisches Journal*, Vol. 346, Sept. 1931, pages 154-156.
The writer confines himself to the technology of different corrosion resistant steels which are brought on the market by the Krupp Co., Essen. EF (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Lime and Ammonia Limit Corrosion. W. T. ZIEGENHAIN. *Oil & Gas Journal*, Vol. 29, June 5, 1930, pages 35, 333.

By injecting a lime-oil slurry into the crude oil charging line to the pipe stills and ammonia gas into the vapor inlet on the towers, the Pure Oil Co., at its Smiths Bluff, Tex., refinery, has eliminated excess corrosion when topping Winkler County, West Texas, crude. The system does not call for a large investment, requires very little attention to operate and may be applied to a cracking operation as well as topping. Enough lime is injected to completely neutralize the acids formed in the oil during heating, but no trouble has been witnessed with excess lime showing up as basic sediment in the fuel oil. The only apparent effect of adding the lime in burning the resultant fuel residuum is that a fluffy deposit of calcium sulphide or calcium sulphate slowly collects on the upper side of the tubes in the convection section of the pipe stills and becomes sufficiently heavy in 10 days to necessitate its removal. This is easily done with compressed air. VVK (4)

The Corrosion of Light Alloys. *Foundry Trade Journal*, Vol. 35, Nov. 19, 1931, pages 324, 326.

A description of the methods which have been selected by a Commission of the heads of different research laboratories, acting in conjunction with the Bureau International de l'Aluminum, for measuring the corrosion of light alloys of aluminum. The necessity for stating the exact analysis of the alloy, its state and any treatment it may have received, and the condition of its service is emphasized. The dimensions of test pieces to be used in all tests are described. Other details, such as dimensions of containers, temperatures of the tests, methods of suspending test plates and correct methods for cleaning the test pieces, are described. A modified Mylius' test is described, and salt spray and immersion tests are also dealt with. OWE (4)

The First Report of the Corrosion Committee to the Iron & Steel Industrial Research Council. *Iron & Steel Institute, Advance Copy*, May 1931, 268 pages. Price 15 s.

Section A—Introduction—describes object and scope of work outlined. The object is to study the phenomena of corrosion of steel and to devise methods for reducing corrosion. Reports are to be published from time to time through the Iron and Steel Institute. Section B—Critical Discussion of the Replies to the Committee's Questionnaire—discusses the replies received from both makers and users. The concensus of opinion seemed to be that failure of steel by corrosion was generally due to lack of adequate protection rather than to defective material. A small amount of Cu was generally believed to increase corrosion resistance. Section C—Summary of the Papers and Other Information Submitted to the Committee—includes discussion of general knowledge of corrosion, behavior of steels in specific conditions, and methods for determining resistance to corrosion. Section D—The Committee's Field Tests—J. C. Hudson describes in detail the field tests planned, and the work accomplished. Careful observations and records are being made of the steels tested from the time of manufacture to the completion of the tests. The variables include rolling practice, and methods of manufacture. For these field tests 4 main exposure stations in Great Britain and 8 substations in various parts of the world to represent all conditions of temperature, humidity and air polution have been selected. The stations in England include mild industrial, very severe industrial, and severe marine conditions and heavy rainfall and possible salt air in the absence of any artificial polution. Of the substations 2 are in Lagos, Africa and offer marine and dry inland conditions respectively, one in Egypt and another in Mesopotamia offer dry hot climatic conditions and the station in Singapore offers tropical marine atmospheric conditions. The tests are divided into three parts (1) mild steel (0.2% C and 0.6% Mn) with and without Cu addition, (2) wrought iron and ingot iron, and (3) effect of process of manufacture. Part 1 is now in progress and parts 2 and 3 are in active preparation. Various protective coatings including paint and galvanizing are included. Section E—Laboratory Corrosion Tests—the development of a laboratory spray test that indicates "liability to commence rusting" is described by U. R. Evans and S. C. Britton. This method of testing was tried out on a large scale by W. H. Hatfield and H. T. Shirley. Results of a laboratory spray test and exposure tests on the same materials are given by J. C. Hudson, who found that there was fair agreement between the 2 tests. Section F—Bibliography of Copper Steels—contains 214 references dealing with the complete effects of Cu on iron and steel. JLG + WLC (4)

Studies of Corrosion. (Etude de la Corrosion.) *L'Usine*, Vol. 40, Dec. 31, 1931, pages 29-31.

A general review of the theories of corrosion and the means to protect metals and alloys by surface treating, plating and coating. Ha (4)

Corrosion of Non-Oxidizing Steels. (Corrosion des Aciers Inoxydables.) *L'Usine*, Vol. 41, Jan. 8, 1932, page 31.

The test results of rust-proof steels of the following types: 18 Cr - 8 Ni; 10 Cr - 23 Ni, 13 Cr, pure Fe, are reproduced in diagrams which were made according to the specifications of the French Air Ministry. It was found that in order to obtain the highest corrosion resistance the surface must have a polish as fine as possible. Ha (4)

Real Progress Being Made in Treatment of Water to Prevent Corrosion. *Water Works & Sewerage*, Vol. 78, Aug. 1931, pages 217-221.

The corrosion of filtration plants and the means which have been developed to prevent it by treating the water are reviewed and their efficacy is discussed. The list of references covers the entire historical development. Ha (4)

Preliminary Report of the Copper Pipe Committee. (Voorloopig Rapport Van De Koperen Buizen Commissie.) *Water en Gas*, Vol. 15, June 12, 1931, pages 113-117; June 26, 1931, pages 125-127.

In 1927 the Society for Water Works Interests of the Netherlands appointed "The Copper Pipe Committee" which was instructed to answer the question: "Is the use of Cu pipe permissible for the distribution of drinking water?" This committee was comprised of representatives of state and city water, sanitary, municipal, chemical, bacteriological and medical departments. The work reported by Thresh in England and the German Federal Sanitary Bureau is outlined and the general conclusions drawn from these works tabulated. A survey was made to determine the amount of Cu normally absorbed by a human with different nutritive substances and was found to be of the order of 15-20 milligrams in 24 hours. The conclusion drawn was that no effect detrimental to health need be feared if the amount of Cu dissolved by water that remains in a Cu pipe for 16 hours is not greater than 3 mg./l. Tests of the same nature established a limit of ten gamma (one gamma equals 0.001 mg.) per liter for As in connection with the use of arsenical Cu as a water conductor. The Committee also investigated whether the occurrence of taste furnished a limiting value for the permissible quantity of dissolved Cu. Three types of ¼" pipe were used in the investigation: (1) electrolytic Cu (99.9%); (2) Cu containing a small amount of As (99.5% Cu, and 0.25-0.45% As); (3) tinned Cu pipe. Three types of waters were used in the tests: (1) dune water (2) river water (3) ground water; which were considered representative of the ordinary types of water handled in commercial installations. Tests of the three compositions of pipe were carried out in identically the same way, the installations being made in various pumping stations. Each installation consisted of a slightly inclined ¼" pipe made up of two pipes with a length of about 5 meters and provided with the necessary stop and drain cocks. The entire system was connected to the main supply pipe of the pumping station by a lead pipe tinned inside. In order to obtain representative conditions a continuous flow of water (50 l./hr.) was specified, the flow in each case being shut off 16 hours before the sample was withdrawn, giving a specimen which had been in contact with stagnant water for this period. The assumption that more Cu would be dissolved under stagnant than flow conditions was confirmed. Service difficulties with tinned Cu pipe result from: (1) substitution of Sn:Pb and other compositions instead of pure Sn, in which the removal of Pb by the action of water may have a more harmful effect than Cu; (2) the comparatively thin coating which is applied commercially. Preliminary tests were made under normal conditions over a period of a year, while a second group were tested in water heated to 80-90° C., the normal temperature in hot water circuits. A number of installations were made throughout the Netherlands and were tested periodically, each installation having a unit of electrolytic and one of arsenical Cu under test. Resin had been used by the manufacturers for bending the tubing and after a large amount of data had been collected, it was found that a film of resin remaining in the tubes had served as a protective coating. The film, however was subsequently removed by the flow of water exposing the Cu for attack. A third group of test sections were installed from which the resin had been removed and the results are comparable with the original tests. Waters which had remained in contact with the sections for long periods of time were used in the preparation of various vegetables in order to note the behavior of foodstuffs with contaminated waters. No discoloration or taste resulted in any of the cooking experiments. The final results varied according to the types of water handled and only very general conclusions were drawn. The fact that some As was removed was evident, but in no case was it found to exceed the permissible limit (10 gamma). Pure food laws are cited which show that in cases as high as 700 mg. $CuSO_4$ per kg. are permitted. Arsenic contents of waters from the tests are not given, but it is stated that "these are not included because the investigation showed in a satisfactory manner that in general there was no question of an approximation to the limit of permissibility." Tests are still being carried on and the results will be published at a later date. Summary of conclusions: (1) no danger results from the use of Cu pipe if the Cu content does not exceed 3 mg./l., and if the As content of the water is not higher than 10 gamma/l; (2) a maximum contamination results after a few weeks of installation and thereafter tends to reach equilibrium and dissolve Cu at a very slow rate; (3) less Cu is dissolved in hot than in cold waters; (4) the quantities of As dissolved from As-bearing Cu pipe is considerably lower than the established limiting value and may be used without objection; (5) commercial wall thicknesses are sufficient to give long life; (6) the use of tinned Cu pipe is not to be recommended pending completion of tests in progress; (7) no harmful effect on health or disagreeable taste were noted in cooking experiments conducted with contaminated water; (8) the use of Cu is considered permissible for both hot and cold water conductors from the various pumping stations at which the tests were conducted. GLC (4)

Metal Surface Treatments. *Electrical Review*, Vol. 109, Oct. 16, 1931, page 598.

Brief description of the rust-proofing and paint-priming processes for iron and steel, Parkerizing and Bonderizing. The former consists of an immersion of parts in a solution made up of boiling water and "Parco" powder; the latter is a chemical priming process for changing the surface of iron or steel to a non-metallic coating which is an integral part of the metal. Ha (4)

Scale Prevention in Closed Feedwater Heaters. J. ALSBERG. *Railway Mechanical Engineer*, Vol. 105, Nov., 1931, pages 537-538.

The prevention of scale in locomotive feedwater heaters which also prevents, to a great extent, the heat transfer through the pipes to the water can be secured by the use of anti-foaming compounds, especially tannin. This was added in the form of briquettes from powdered extracts. An emulsion of castor oil and tannin also seems to be useful, but the tests are not yet completed. Ha (4)

Corrosion from Flue Gases. DAVID BROWNLIE. *Engineering & Boiler House Review*, Vol. 45, Oct., 1931, pages 206-207.

A continuation of the discussion begun in the Sept. 1931 issue of some methods of preventing corrosion in boilers, air heaters, and economizers. In explaining the reasons for the trouble, the recommendation is made to feed economizers and boilers with warm inlet water to minimize the stress due to temperature differences. Another remedy would be the use of absolutely non-corrodible steels. High costs often prevent the use of this course. Reduction of the S content of the coal should also be attempted. Ha (4)

The Constitution of Iron Scale. L. B. PFEIL. *Rolling Mill Journal*, Vol. 5, Aug. 1931, pages 551-554, 557-558.

The determination of the limiting composition of iron oxide in its different forms and phases is dealt with on the basis of the equilibrium diagram Fe-O-C between the percentages of 70 to 78% Fe; four phases are distinguished in this range: ferric oxide phase, the magnetic phase, Fe_3O_4, the ferrous phase, and the Fe and Fe oxide phase; each phase is discussed separately with regard to conditions of temperature and solubility. See also *Metals & Alloys*, Vol. 2, Nov. 1931, page 248. Ha (4)

Zinc Sulfate to Combat Corrosion. *Refiner*, Dec. 1931, page 87.

The Dixon Creek Oil and Refining Company has a 3500 bbl. skimming plant near Kingsmill which operates on Gray County, Texas, crude oil containing so much hydrogen sulphide that it gave constant trouble from corrosion of the steel vapor lines from the fractionating towers to the condensers. Even the admiralty tubes of the condensers were affected, and output was being lessened. Caustic having proved ineffective, zinc hydroxide was tried. To a solution of 2¼ parts of caustic in 100 parts of water, 2¾ parts of zinc sulphate is added. The solution is pumped by a Westco turbine pump to a point in the vapor line near the tower and sprayed into the vapors. Zinc sulphide is formed and settles out in the rundown tanks. Approximately 2.35 lbs. of caustic and 4.74 lbs. of zinc sulphate are required to remove 1 lb. of hydrogen sulphide. Such a quantity of the chemical is used that the test copper strip shows merely a faint peacock tinge. Instead of frequent or almost daily shut-downs, there were no shut-downs for corrosion repairs from May 10 to Sept. 10, 1931, and no signs of continued corrosion. (4)

Problems Involved in Corrosion and Metal Protection (Fragen der Korrosion und des Metallschutzes). B. SCHEIFELE. *Korrosion und Metallschutz*, Vol. 7, Aug. 1931, pages 216-217.

Review of the papers dealing with corrosion problems and presented at the General Meeting of the Verein deutscher Chemiker and the deutsche Bunsen Gesellschaft für angewandte physikalische Chemie, Vienna, May 1931. EF (4)

The Resistance to Corrosion by Sea-Water of Cadmium Coatings on Iron and Light Metals. (Seewasserbeständigkeit galvanischen Ueberzüge auf Eisen und Leichtmetallen.) E. K. O. SCHMIDT. *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 22, Mar. 14, 1931, pages 141-147.

The investigation was undertaken in order to ascertain the resistance to corrosion by sea-water of cadmium coatings, deposited on iron and light metals, by the galvanizing process. The conclusion of these tests as regards light metals, are the following: cadmium on Duralumin and Lautal shows, in spite of some difficulties of applications encountered by plating, a very good protective capacity. This protective capacity is much higher than the one ascertained for rubber coatings. On the contrary, for Elektron, cadmium plating did not give satisfactory results. WHB (4)

Oxidation of Some Copper Alloys (Die Oxydation einiger Kupferlegierungen). J. ST. DUNN. *Korrosion und Metallschutz*, Vol. 7, Oct. 1931, page 250.

Discussion on a paper presented before the Institute of Metals, Zurich, Sept. 1931. EF (4)

Corrosion Research and Production of Brines for Refrigeration Purposes (Korrosionsforschung und Kühlsolefabrikation). J. WIESENT. *Zeitschrift für die gesamte Kälte-Industrie*, Vol. 38, Feb. 1931, pages 21-23.

The author confines himself to a discussion on the alkaline chromate addition to refrigeration brines. EF (4)

Corrosion Resistant Alloys of the Stainless Type in Use and Fabrication. T. H. NELSON. *Engineering*, Vol. 131, June 19, 1931, page 802; *Metal Stampings*, Vol. 4, June 1931, page 486.

Paper read before the American Iron & Steel Institute, May 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 246. LFM+JN (4)

Zinc in the Construction of Cups for Leclanche Cells. (Zink im Elementbecher.) E. SCHRADER. *Zeitschrift für Metallkunde*, Vol. 23, Nov. 1931, pages 301-305.

The author has observed that Zn sheet will dissolve in dilute acids more rapidly upon one side than upon the other. A rolling practice for preparing sheet Zn to be manufactured into cups is recommended. The effect of impurities and of amalgamation are discussed. The causes of corrosive attack—which is chiefly in pits—are partly elucidated. The author has been able largely to eliminate differences in corrosive attack on the 2 sides. RFM (4)

Protection of Aluminum and Aluminum-Alloys Against Sea-Water (Schutz von Aluminium und Aluminiumlegierungen gegen Seewasser). E. K. O. SCHMIDT. *Korrosion und Metallschutz*, Vol. 7, July 1931, pages 153-158.

The paper presented before the Reichsausschuss für Metallschutz, Kiel, 1930, summarizes the present state of corrosion protection of Al and its alloys against sea water. The paper is particularly concerned with the improvement of the corrosion stability by (1) suitable alloying, (2) special heat treatment, (3) application of metallic and other coatings. EF (4)

The Protection of Magnesium Alloys Against Corrosion. H. SUTTON & L. F. LE BROCQ. *American Metal Market*, Vol. 38, Sept. 25, 1931, pages 5, 9; Sept. 26, 1931, pages 5, 9, 10; *Engineer*, Vol. 152, Sept. 25, 1931, pages 330-331; *Korrosion und Metallschutz*, Vol. 7, Oct. 1931, pages 249-250.

Paper presented at Institute of Metals meeting, Sept. 14, 1931. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 6. DTR (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

The Equilibrium Diagram of the Copper-rich Copper-Silver Alloys. Cyril Stanley Smith & W. Earl Lindlief (American Brass Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 433, Sept. 1931, 16 pages.

The liquidus was determined from cooling curves. The solidus and limit of solid solubility of Ag in Cu were determined by microscopic examination of heat treated alloys. The solid solubility curve obtained was in good agreement with the curves recently published by Stockdale and by Ageew, Hansen and Sachs. Attempts to produce age hardening, which would be expected to result from the change in solubility with temperature, were unsuccessful. Previous work on the Cu-rich portion of the diagram is critically reviewed. 22 references. JLG (5a)

On the Detection of Sulphur in Steel Specimens by the Printing Method (Ueber den Nachweis des Schwefels in Stahlschliffen durch das Abdruckverfahren). H. J. van Royen & E. Ammermann. *Archiv für Eisenhüttenwesen,* Vol. 4, Mar. 1931, pages 435-438; *Stahl und Eisen,* Vol. 51, Apr. 9, 1931, pages 462-463.

The investigation was undertaken to check the results of M. Niessner (*Archiv für Eisenhüttenwesen,* Vol. 3, 1929, pages 157-161). Niessner claimed to have proven that the yellow color of the sublimate print when subjected to Feigl's iodine-acid reaction indicates the S. Since the authors are of the opinion that the method of Niessner does not prove the absence of P, they developed a new method which strictly indicates only the S present by a color which is independent of the amount of S in the steel. 2 solutions are necessary. Solution 1 contains in one liter, 25 g. cadmium acetate + 200 cc. 80% acetic acid; to this solution is added a solution of 50 cc. H_2SO_4 (specific gravity 1.84) in 950 cc. H_2O. Solution 2 contains 120 g. $CuSO_4$ + 880 cc. H_2O + 120 cc. H_2SO_4 (1.84). The specimen to be tested is pressed upon gelatine paper which has been treated with solution 1 for 2-4 mins. Yellow cadmium acetate is precipitated and transformed to the dark brown to black Cu_2S in solution 2 (2-3 mins.). The prints are then washed and dried. P is not indicated by this method. GN (5a)

Austenite-Martensite Transformation and Theories of Steel Hardening. (Austenit-Martensit-Umwandlung und Stahlhärtungstheorie). S. Steinberg. *Archiv für Eisenhüttenwesen,* Vol. 5, Jan. 1932, pages 383-385.

Report of the Uraler Institut für Metallforschung. Through dilatometric and metallographical investigation on C steels, containing 0.7, 0.98 and 1.32% C, it was determined that supercooled austenite is transformed at temperatures from 200 to 350° C., more or less gradually into martensite. Stability of supercooled austenite (at constant temperature) increases rapidly with temperature drop and higher C content. Independent of the rate of cooling, austenite is converted chiefly into martensite upon further cooling to room temperature. Transformation temperature drops with a rise in C content. From magnetic measurements, less residual austenite was present in the hardened steels of heterogeneous structure, after rapid cooling than after slow cooling. An exception to this was in the case of steel with 1.60% C, of a homogeneous structure, in which more austenite was present after slow cooling. Hanemann's Phase Theory & Tammann & Scheil's Tension Theory of steel hardening are discussed on basis of experimental results. Results are not in accord with Hanemann's Phase Theory. Tension forces are set up by martensite crystals in the surrounding austenite. These forces in tension are not uniformly distributed; they are greater in direction of crystallographical surfaces. Perpendicular to these surfaces compression forces are produced which arrest austenite transformation. In this way origin of peculiar martensite needle structure may be explained, all in accord with the Tension Theory of steel hardening. GN + DTR (5a)

Dilatometric Anomalies in Soft Carbon Steels. (Étude sur des aciers ordinaires doux et extra-doux notamment au point de vue des anomalies dilatométriques.) J. Seigle. *Congrès International des Mines, de la Metallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 365-383; *Metallbörse,* Vol. 20, Aug. 23, 1930, page 1885.

The position of Ar_3 and Ac_3 and the spread between the 2 points was studied dilatometrically on low carbon steels, Armco, wrought iron, etc. in a number of cases after decarburization by heating in hydrogen. The data are shown in 28 figures. The results are explainable on the basis of the effect of phosphorus and other impurities on the position of the α - γ transformation. Deformation at high temperatures also seems to have an effect. See also *Metals & Alloys,* Vol. 1, Dec. 1930, page 907. HWG + WHB (5a)

Plane Polarized Light in the Microscopic Investigation of Ores and Metals. Freleigh Fitz Osborne. *Canadian Mining and Metallurgical Bulletin* No. 237, Jan. 1932, pages 1-13.

A general discussion. AHE (5a)

Microstructure of Pig and Cast Iron. (Gefüge-Ausbildung von Roh-und Gusseisen.) H. Pinsl. *Giesserei-Zeitung,* Vol. 27, Aug. 15, 1930, pages 436-447.

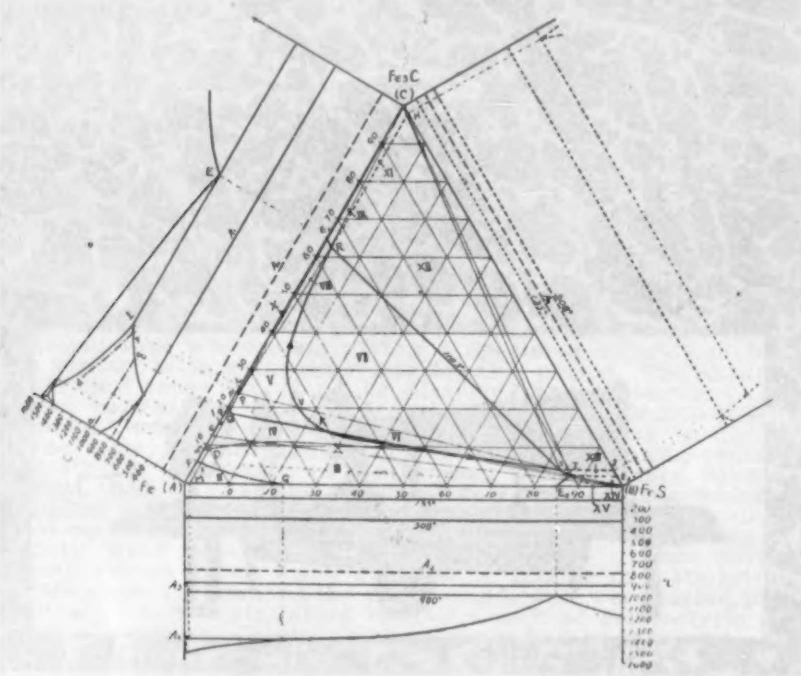
A series of 133 photomicrographs showing the various structures of P, graphite, combined C and slag in pig Fe and cast Fe. (5a)

Dilatometric Analysis and the Quality of Metallurgical Products (L'analyse dilatométrique et la qualité des produits métallurgiques). Pierre Chevenard. *Revue de Métallurgie,* Vol. 28, Oct. 1931, pages 565-569.

Basic principles and the results obtained with dilatometric analysis are described. All physico-chemical transformations, many structural changes and modifications due to recrystallization, disappearance of the internal stresses are sharply shown on dilatometric curves. Whatever might be their intensity, rapidity or slowness, they can be ascertained with certainty and subjected to quantitative study by simple and convenient technique. JDG (5a)

On the Equilibrium Diagram of the Fe-Fe_3C-FeS System. Tomo-o Sato. *Tetsu to Hagane*, Vol. 17, Nov. 1931, pages 1126-1149.

By utilizing thermal and microscopic analyses the equilibrium diagram of the Fe-Fe_3C-FeS system was thoroughly investigated. Electrolytic iron, pure white pig iron and pure FeS were melted together in a Tammann furnace, under a cover of fused glass in which Na_2CO_3 added in a proportion of 6 : 1 to protect the oxidation of the melt. 75 alloys, 0-62.1% Fe_3C and 0-89.0% FeS, thus prepared were subjected to the thermal analysis. Fig. 1 shows the projectional diagram of this whole system, to which 3 binary equilibrium diagrams are attached. In this system, there exist two liquid phases, m_1 and m_2, in a certain composition range, which is evidently proved by two layers in the solidified mass. The under layer, m_1, consists of the phase rich in Fe and Fe_3C, while upper layer, m_2, of that rich in FeS. By a monotectic reaction, $m_1 \rightleftarrows m_2 \pm \gamma$, these 2 liquid phases change their mutual solubility, and then a monotecto-eutectic reaction, $m_1 \rightleftarrows m_2 + \gamma + Fe_3C$, at 1,103° take place. At last, by a ternary eutectic reaction, $m \rightleftarrows \gamma + FeS + Fe_3C$, at 968° the solidification finishes in cooling. The A_4, A_3, A_2, and A_1 critical points of iron are almost unaffected by addition of S, showing that the S is only very slightly soluble in the solid



iron. The binary equilibrium diagram of Fe-FeS system obtained by the present investigation agrees with those of the former investigators; the A_4, A_3, and A_2 critical points of the alloys were determined experimentally in the present investigation. From the experimental results the isothermal diagrams, section diagrams and projection diagram of the space model of this ternary system were constructed. A qualitative binary diagram of Fe_3C-FeS system was deduced from the diagrams of the ternary system. TS (5a)

Recent Results on the Migration Phenomena in Crystallized Solid Bodies. (Neuere Ergebnisse über Wanderungsvorgänge in kristallisierten Festkörpern.) A. Smekal. *Zeitschrift für physikalische Chemie*, Bodenstein Festband, 1931, pages 442-452.

The theoretical discussion takes the following steps: Temperature laws and transference ratios of solid ion conductors. Permanent conductivity and "true conductivity." Problem of "best conducting" group of matter. Foreign diffusion and loose structure of true crystals. EF (5a)

Melting Diagrams of the Systems Zirconium-Dioxide—Beryllium oxide. (Schmelzdiagramme des Systems Zirkondioxyd—Berylliumoxyd.) O. Ruff, F. Ebert & H. V. Wartenberg. *Zeitschrift anorganische und allgemeine Chemie*, Vol. 196, Mar. 5, 1931, pages 335-336.

Tests employing X-ray methods were made whereby a compound $ZrCaO_3$ with a melting temperature of 2350°C. could be determined with certainty. Ha (5a)

A Thermodynamic Study of the Iron-Carbon System in the Solid and Liquid States I. II. Yap, Chu-Phay. *Transactions Faraday Society*, Vol. 27, Dec. 1931, pages 777-790, 790-797.

The application of the thermodynamic laws of the depression of the freezing point to the iron carbon system indicates that the heat of fusion of γ iron is 66.4 cal./g. and heat of transition of $\gamma \rightarrow \delta$ iron is 2.2 cal./g. and of α-γ change is 5.5 ± 0.2 cal./g.

The heat of solution of Fe_3 C in austenite is about 5700 cal./mol. The solute in austenite is carbon at temperatures above 1020° C and below it is Fe_3C. Considerable discussion on the interpretation of results obtained by thermodynamic methods is given. PRK (5a)

A New Mono-Metallic Disturbance with Compensation Effect by Thermal Anistropy (Eine neue monometallische Unruhe mit Kompensationswirkung durch thermische Anistropie). R. Straumann. *Zeitschrift für Instrumentenkunde*, Vol. 51, July 1931, pages 379-380.

Refers to a lecture delivered at the Meeting of the Gesellschaft für Zeitmesskunde und Uhrentechnik, Kassel. The compensation effect of the new disturbance is accomplished by rolling the material in a certain direction, resulting in the phenomenon of thermal anisotropy, i.e., the materials show materially different coefficients of thermal expansion towards different directions. The following materials are considered: elinvar, single crystals of metals, Zn-Cu alloys with 3-5% Cu and Zn-Cd alloys containing 20% Cd. Related problems, such as degree of rolling, heat treatment, aging phenomena, X-ray structure are briefly dealt with. EF (5a)

Contribution to the Binary Systems of Aluminum and Cadmium, Lead and Bismuth. (Zur Kenntnis der Zweistoffsysteme des Aluminiums mit Cadmium, Blei und Wismuth.) M. Hansen & B. Blumenthal. *Metallwirtschaft*, Vol. 10, Dec. 4, 1931, pages 925-927.

Contains 8 references. Slight solubility of Cd, Pb and Bi in liquid Al was proved by determination of cooling curves with Pt-Pt Rh thermocouple. The Al used was 99.91% pure. The maximum reduction in melting point produced by Cd was 11° at 5% Cd, by Pb 1.5° and by Bi 3.5° C. Al was practically insoluble in molten Cd, Pb and Bi. The solubility of Cd in solid Al is less than 0.97% at 550° C. and decreases at lower temperature. The hardness of Al-Cd alloys can be increased about 40% by heat treatment. CEM (5a)

Pure Tin has no Allotropy. Correspondence from K. Honda, Sendai, Japan. *Metal Progress*, Vol. 20, Nov. 1931, page 80.

The writer reports work on Cd-Sn equilibrium showing no transformation in pure Sn. WLC (5a)

Properties of Atomic Hydrogen. III. Mercury Hydrides. (Zur Kenntnis des Verhaltens von atomarem Wasserstoff. III. Zur Kenntnis des Quecksilber-hydrids.) A. Klemenc & F. Patat. *Zeitschrift für physikalische Chemie*, Sec. A, Vol. 158, Dec. 1931, pages 65-77.

The reactions in the system Hg-H_2 occurring under the influence of the resonance radiation are due to the atomic hydrogen. EF (5a)

Remarks on Drawing Equilibrium Diagrams. (Remarques sur le trace des diagrammes d'equilibre.) L. Grenet. *Aciers Speciaux Metaux et Alliages*, Vol. 6, Jan. 1931, pages 2-10; July 1931, pages 319-332.

This thesis in two articles is a critical review of methods for obtaining equilibrium diagrams. The author advocates the use of thermodynamics along with the observed facts when the equilibrium diagram of a system is to be finally drawn. Based on his theoretical consideration, the author advances the statement that all the existing equilibrium diagrams may have to be radically changed in order to include all the thermodynamical factors of the system. GTM (5a)

The Ternary System Iron-Chromium-Nickel. (Das Dreistoff-system Eisen-Chrom-Nickel.) W. Jellinghaus. *Stahl und Eisen*, Vol. 51, May 21, 1931, pages 651-652.

A review of the recent work on the equilibrium diagram of the system Fe-Cr-Ni, as carried out at the Kaiser Wilhelm Institut für Eisenforschung in Düsseldorf. Ha (5a)

The Constitution of Austenite and of The Solid Solution of Carbon in δ Iron and of the Liquid Solution in Equilibrium with these, Examined Thermodynamically. F. H. Jeffery. *Transactions Faraday Society*, Vol. 27, Dec. 1931, pages 751-755.

Austenite is a solid solution of monatomic carbon in δ iron and not of Fe_3C in iron. The liquid phases in equilibrium with the solid solutions of δ iron and of austenite consist of monatomic carbon molecules in monatomic iron molecules. The solid solution derived from δ iron is monatomic molecules of carbon in monatomic molecules of δ iron. PRK (5a)

The Formation and External Form of Segregates from Metallic Solid Solutions. (Ueber die Entstehung und Ausbildungsform von Segregation in metallischen Mischkristallen.) H. Hanemann & O. Schröder. *Zeitschrift für Metallkunde*, Vol. 23, Oct. 1931, pages 269-273, 297-300.

It is assumed that the formation of segregates (precipitates) from super-saturated solid solutions is a result of a diffusion of atoms in columns along preferred crystalline directions characterized by close packing of atoms and maximum separation from similar columns, and by the presence of only one type of atom in the diffusing column. This type of diffusion is called "perfusion." If diffusion cannot take place in this way (as in solid solutions of the substitutional type) the segregation is very slow and leads to the formation of a fine structure, as in duralumin, rather than a gross structure, as in the steels and brasses. The external form taken by the segregate is determined by the crystallographic directions selected for perfusion. The growth direction of the segregate is most probably half-way between two such perfusion directions. It is stated that ferrite segregates from austenite (in the Fe-C system) upon both the octahedral and cube planes in the austenite, and that the α-phase segregates from the β-phase in the Cu-Zn system upon the octahedral planes in the β-phase, phenomena which may be understood upon the theory elucidated. The geometry of the traces of segregate needles or plates upon a surface of polish is discussed. RFM (5a)

Effect of Heat Treatment upon Ferrite Banding in Steel. W. E. Harvey & Bradley Stoughton. *Fuels & Furnaces*, Vol. 9, Oct. 1931, pages 1151-1152, 1162.

Paper read before the American Society for Steel Treating, Sept. 1931. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 14. MS (5a)

The Equilibrium Diagram of Copper-Gold Alloys. (Das Zustandsdiagramm der Kupfer-Gold-Legierungen.) G. Grube, G. Schönmann, F. Vaupel & W. Weber. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 201, No. 1, 1931, pages 41-47.

Copper-gold alloys crystallize from their melts in a continuous series of solid solutions which show at 59.5 atomic % a minimum of the solidification temperature at 884° C. The electric resistance and the thermal expansion of the alloys was measured from room temperature to 460° C., and the conversion points determined. In the β-solid solutions the ordered distribution of the crystal Cu_3Au was found, in the γ-solid solution the crystal CuAu. The compound Au_3Cu does not exist in the temperature range investigated. The course of the temperature-resistance curves permitted the conclusion that in heating the alloys the transformation occurs in 2 stages; the temperature limits for both stages were determined. Metallographic and micrographic investigation of the alloys confirm the results shown by the equilibrium diagram. Ha (5a)

Automatic Polishing of Metal Specimens. R. G. Guthrie & J. A. Comstock. *Metal Progress*, Vol. 20, Dec. 1931, pages 59-63.

The authors discuss the progress in preparation of metallographic specimens and emphasize its importance in the production of fine micrographs. The automatic equipment in use in their laboratories is described. Uniform surfaces free from scratches or torn out inclusions are produced by automatic polishing. WLC (5a)

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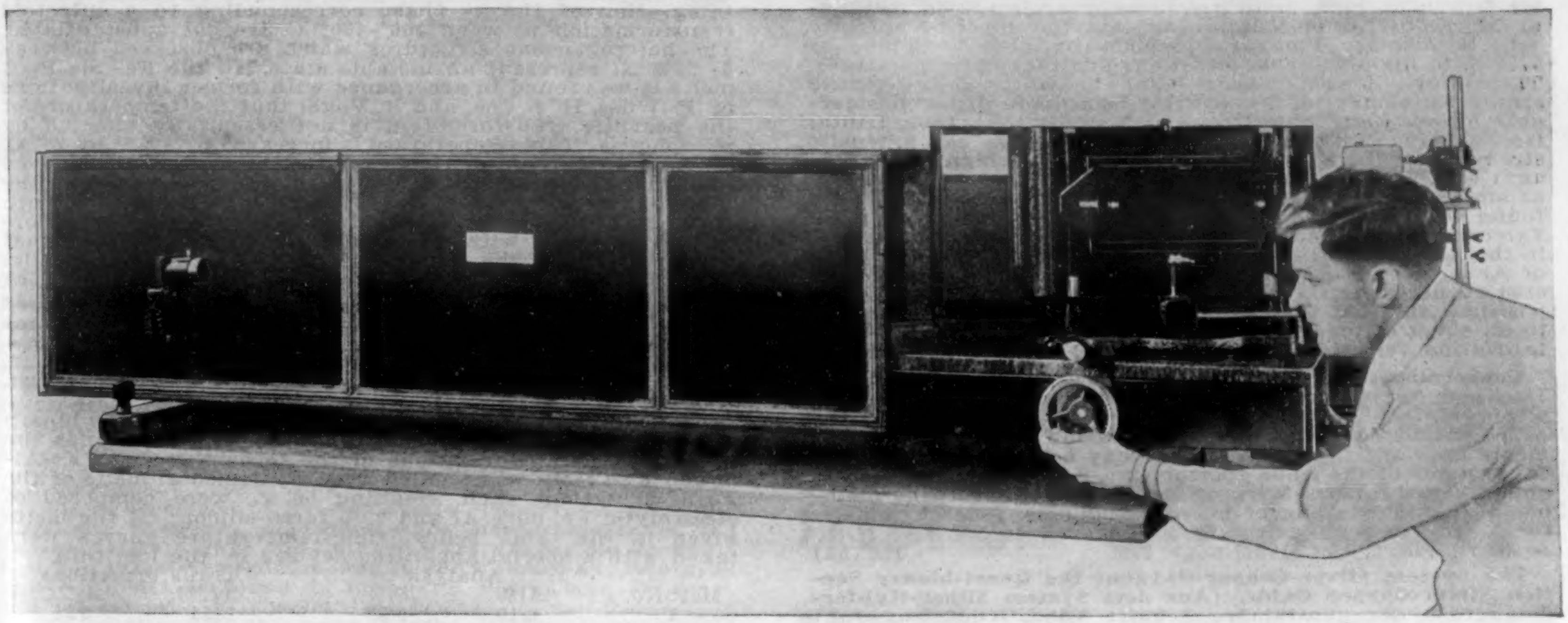

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A Study of Crystallization at Pressures up to 20,000 Atmospheres. (Kristallisationsversuche bei Drucken bis zu 20,000 Atmosphären.) G. Welter. *Zeitschrift für Metallkunde*, Vol. 23, Sept. 1931, pages 255-260.

Includes discussion. Since defects chiefly in the nature of voids are usually in metal castings, diminishing the physical properties, Welter points out that freezing metal melts under pressure should effect an improvement. 5 Al alloys, designated "German alloy," "American alloy," "Silumin, unmodified," "Cetal," "Lautal," were frozen at pressures from 1 to 20,000 atmospheres, the physical properties determined and the metallographic structure studied. In every case the ingot frozen at pressures from 12,000-20,000 atmosphere showed a density greater than that frozen at 1 atmosphere. The high pressure also caused a grain refinement quite separate from any cooling effect. "Silumin" (Al-Si with 13% Si) frozen at high pressures showed a change in metallographic constitution, suggesting that the effect of pressure was to displace the eutectic normally at 12% Si and at 575° C. to higher Si concentrations and higher temperatures. The alloys frozen under high pressure show tensile strengths, elongations, and Brinell hardness often considerably higher than those frozen at 1 atmosphere, thus, Lautal frozen between 12,000 and 20,000 atmosphere has a tensile strength (average) of 34,000 lbs./in.², an elongation (average) of 15%, and a Brinell hardness (average) of 73, whereas similar values for the alloy frozen at 1 atmosphere were found to be 19,000 lbs./in.², 2.1%, and 49. In discussion G. Tammann points out that the displacement of the eutectic in the Al-Si system is not surprising, since the melting point of Al is increased by increased pressure and that of Si decreased necessitating a horizontal shift in the eutectic composition; and that the change in grain size must be ascribed to an effect of pressure upon the nuclei formation and crystallization velocity. RFM (5a)

Concerning the Art of Metallography. Francis F. Lucas. *Heat Treating & Forging*, Vol. 17, July 1931, pages 668-671; Aug. 1931, pages 783-784, 813-814, 817.

The article describes the types and the function of instruments used and the results which may be obtained. The optical systems of the Abbe apertometer, microscope and testing objectives, the Zeiss-Martens metallurgical outfit, the methods of etching, taking of micrographs and "reading" of pictures are thoroughly explained. 8 references. See also *Metals & Alloys*, Vol. 2, Oct. 1931, page 209. Ha (5a)

The System Silver-Copper-Oxygen: the Quasi-binary Section Silver-Copper Oxide. (Aus dem System Silber-Kupfer-Sauerstoff: der quasibinäre Schnitt Silber-Kupfer-oxydul.) J. A. A. Leroux & K. W. Fröhlich. *Zeitschrift für Metallkunde*, Vol. 23, Sept. 1931, pages 250-254.

The results of thermal analytical and micrographical studies of the quasi-binary system Ag-Cu_2O are given. The system is monotectic eutectiferous. The melting point of Cu_2O (approx. 1235° C.) is depressed to 1134° C. by 7% Ag, at which temperature and composition 2 liquid phases result extending to approximately 82%. The eutectic composition is 98% Ag and the eutectic temperature 941° C., the melting point of pure Ag 963° C. Cu_2O dissolves 2.7% Ag in solid solution at 1134° C., the solubility decreasing with decreasing temperature; the solid solubility of Cu_2O in Ag is approximately 0.3% at 941° C. Cupric oxide could not be detected as a constituent, contrary to the findings of Vogel and Pocher, though in Cu_2O-rich melts Cu as a Cu-Ag eutectic was detected. Tentative explanations for these facts are advanced. RFM (5a)

Micro-Analytical Methods. M. E. Long & G. W. Leeper. *Chemical Engineering & Mining Review*, Vol. 24, Dec. 5, 1931, pages 99-101.

A brief review of macro and micro- analysis methods. WHB (5a)

The Alloys of Iron and Manganese. V. N. Krivobok. *Heat Treating & Forging*, Vol. 16, Dec. 1930, pages 1538-1540.

A report on the heat treatment and metallography of the alloys of the 2 metals. The microstructure is discussed in 6 groups: Mn content from 0 to 1.4%; from 1.4 to 2%; from 2 to 16%; from 16 to 30%; from 30 to 60%; from 60 to 100%. The behavior of each group is described and microphotographs of 12 specimens containing from 1.9 to 75% Mn are reproduced. Ha (5a)

Effect of Normalizing on the Grain Structure and Physical Properties of Automobile Sheet Steel. William F. McGarrity & H. V. Anderson (Lehigh University). *American Society for Steel Treating, Preprint* No. 31, 1931, 14 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The authors report a study of normalizing commercial automobile sheets at various temperatures from 1400° to 1880° F. X-ray diffraction methods and microstructural examination were correlated with Erichsen tests for workability. The effect of heating time on grain size is discussed. Temperature of 1700°-1750° F. was found to give the best structure and Erichsen values. See also *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 41. WLC (5a)

On the Formation of Acicular Ferrite in Tungsten Steels. Takejiro Murakami & Shuzo Takeda. *Technology Reports of the Tohoku Imperial University*, Vol. 10, Dec. 1931, pages 267-294.

By dilatometric measurement during cooling under various conditions, the critical points of tungsten steels were determined, and the effects of the change of composition, the maximum heating temperature and the rate of cooling on the critical points were thoroughly investigated. From the microscopic investigation, it was confirmed that acicular ferrite separates at a lowered critical point below 500° C., resulting in the characteristic acicular structure. As the cooling rate increases, the acicular structure gradually resembles martensite, which is formed by quenching, but no distinct boundary can be drawn between the two, the transition being continuous. The change of hardness or electric resistance with the cooling rate is also continuous. From these results the mechanism of the formation of acicular ferrite in tungsten steels were satisfactorily explained by Tammann's theory, assuming the crystallization curve for the respective phases, i.e., ferrite, carbide and martensite. TM (5a)

Differential Thermal Analysis of Iron Alloys. (Thermische Differentialanalyse von Eisenlegierungen.) E. Söhnchen & H. Nipper. *Stahl und Eisen*, Vol. 51, Dec. 31, 1931, pages 1618-1620.

Report from the Foundry Institute of the Technische Hochschule Aachen. The paper briefly describes first a new simple apparatus for taking thermal differential curves and then reports the results of investigations which were carried on on alloys of Fe-Ni, Fe-Si - P - C and Fe - Si - Ni- C. In the system Fe-Ni the data on the course of the γ-transformation and on the range and nature of the heterogeneous field ($\alpha \rightarrow \gamma$-phase) are still very contradictory, but the authors' results show, in accordance with those of former investigations by T. Kasé, K. Honda & S. Miura, P. Chevenard, and A. Merz, that the A''' transformation gradually decreases with increasing content of nickel. The results by F. Osmond, and D. Hanson & H. E. Hanson who found a disintegration of the γ- phase corresponding to a eutectoid transformation between 300°-400° C are not substantiated. The heterogeneous structures which are observed between 5- 35% Ni represent an instable state. In the Fe- Si- P- C melts it was found in accordance with former investigations by F. Wüst, H. J. Coe, and R. Vogel that the temperature of the pearlitic transformation is not essentially affected by phosphorus. This temperature is increased by 1% P by 25° C. No further increase of the pearlitic temperature is observed with higher contents of P and in the presence of Si. In the system Fe- Ni- Si- C melts with 1% and 2% Si and with either 1.75% or 3.5% Ni were investigated. The A' transformation increases with increasing content of Si, but so that the A' curve for the higher Ni content is running parallel below that of the lower Ni content. 14 references. GN (5a)

Two Examples of Ternary Systems of Iron with Closed γ-Field (Zwei Beispiele von Dreistoffsystemen des Eisens mit geschlossenem γ-Raum). F. Wever & A. Heinzel. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, No. 16, Report 186, 1931, pages 193-197; *Stahl und Eisen*, Vol. 51, Oct. 1, 1931, pages 1237-1238.

The simultaneous effect of 2 alloying elements, the binary system of which with iron shows a closed γ-field, upon the polymorphic transformations of the ternary systems Fe-Al-Si and Fe-Cr-Mo was studied. The experimental melts of the Fe-Al-Si system, each weighing 50 g., were composed of electrolytic Fe, pure Al and 93% ferro-silicon. Of the melts given in the table below, time-temperature curves were taken with a special apparatus devised by the institute.

	Analysis		Transformations	
Melt No.	Al%	Si%	A_4 °C	A_3 °C
1	0.19	0.58	1351	952
2	0.31	0.93	1300	1014
4	0.43	1.21	....	....
5	0.50	1.33	....	....
18	0.49	1.60	....	....
6	0.16	0.25	1385	905
7	0.44	0.53	1326	976
8	0.71	0.65	1270	1048
9	0.78	0.64	....	....
10	0.91	0.85	....	....
19	0.90	0.98	....	....
11	0.44	0.19	1350	935
12	0.48	0.13	1347	948
13	0.64	0.23	1275	1030
14	0.74	0.24	1303	1000
15	0.93	0.36	1235	....
16	0.99	0.41	....	....
17	1.14	0.44	....	....

The results show that the stability field of the face-centered γ-solid solutions is closed by a ruled surface of straight line isotherms which connect the boundary curves of the 2 binary systems. The simultaneous effect of the 2 elements is a strictly additive one and can be calculated by means of a simple linear equation. The diagram is shown. The melts for the system Fe-Cr-Mo were made of electrolytic Fe, Cr containing 99.2% Cr, 0.01% C and pure Mo powder and investigated by the same method as the Fe-Al-Si melts. The results are as follows:

	Analysis		Transformations	
Melt No.	% Cr	% Mo	A_4 °C	A_3 °C
1	0.94	1.31	1329	928
2	1.16	1.72	1292	948
3	1.33	2.40	1221	977
4	1.62	2.39	1178	983
5	1.67	3.04	....	...
6	1.94	3.47	....	...
7	1.11	0.47	1372	896
8	1.55	0.97	1351	898
9	2.07	1.40	1322	886
10	2.67	1.71	1276	904
11	3.44	2.17	1205	948
12	4.43	2.32	....	...
13	4.94	2.63	....	...
14	2.63	0.57	1353	870
15	3.39	0.79	1327	852
16	4.25	1.16	1300	851
17	5.71	1.47	1243	870
18	7.37	1.53	....	...
19	8.08	1.84	....	...

The equilibrium field of the ternary Fe-Cr-Mo-γ-solid solutions is shown. In both of the binary systems FeCr and Fe-Mo the decerase of the A_4 transformation is more pronounced than the corresponding increase of A_3. The vertex curve of the γ-field, therefore, ascends on the Fe-Cr side from 925° C. at 14% Cr to 1125° C. at 2.5% Mo on the Fe-Mo side. The boundary face of the equilibrium space of the γ-field is bent and, therefore, the isotherms are also bent so that a simple calculation of the simultaneous effect of the 2 elements is not possible. GN (5a)

Problems in the Foundry. Metallography and Foundry. (Probleme im Giessereiwesen. Metallographie und Giesserei.) A. Portevin. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, pages 921-922.

The problems still to be investigated in the production of good castings are reviewed; although metallography has aided in producing a chemically and physically uniform material other factors such as segregation, pipes, fluidity, etc., remain to be studied. Ha (5a)

An X-Ray Study of the Alloys of Silver with Bismuth, Antimony and Arsenic. Part II. S. J. Broderick & W. F. Ehret. *Journal of Physical Chemistry*, Vol. 35, Nov. 1931, pages 3322-3329.

X-ray examination of the Ag-As system supports the thermal diagram of Heike and Leroux in the main. The solubility of As in Ag is approximately 5%, the lattice parameter of the metal being increased from 4.076 A.U. to 4.080 A.U. for the saturated phase. The solubility of Ag in solid As is practically nil. A β phase, containing approximately 7.5% As, appears at higher temperatures, the structure being hexagonal close-packed with an axial ratio of 1.633. The side of the elementary parallelopiped is 2.891 A.U. and the height 4.722 A.U. A discussion of the relationship between the Ag-As, Ag-Sb, and Ag-Bi systems follows. The article is accompanied by 5 tables and 2 diagrams. OWE (5b)

On the Molecular Sphere of Action of Metals. (Ueber die molekulare Wirkungssphäre der Metalle.) C. Benedicks. *Zeitschrift für physikalische Chemie*, Bodenstein Festband, 1931, pages 379-384.

See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 8. EF (5b)

An X-Ray Investigation of the Tin-Antimony Alloys. E. G. Bowen & W. Morris Jones. *London, Edinburgh, Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, Aug. 1931, pages 441-462.

A study of the crystal structure was made by the X-ray powder method. The results confirm the existence of the solid solutions and the Sn and Sb ends of the equilibrium diagram. There is an expansion of the Sn lattice and a contraction of the Sb lattice, showing that the atomic radii of these elements are different. The compound SnSb is found to have a sodium chloride structure which persists alone over the entire range from 40 to 54% of Sb with some change of lattice constant showing that there is slight solution of Sb in SnSb and a greater solution of Sn in SnSb. The individual phases of the equilibrium diagram are discussed. 16 references. Ha (5b)

Diffraction Patterns Explain Metal Crystal Structures. R. L. Davidson. *Steel*, Vol. 88, Mar. 26, 1931, pages 48-50.

The principles of making X-ray diffraction patterns and the manner of determining the structure from the photographs is described in an elementary manner. Ha (5b)

On the Accuracy of Interference Measurements in the Molecule with X-rays and Cathode Rays. (Ueber die Genauigkeit von Interferenz-Messungen in der Molekul mit Röntgen- und Kathodenstrahlen.) L. Bewilogua. *Physikalische Zeitschrift*, Vol. 32, Jan. 15, 1931, pages 114-117.

The question "do the wave lengths of cathode rays yield a larger dissolving power due to their being 10-30 times smaller than the X-ray wave lengths" is critically discussed and its limitations are revealed. Then the following question is brought up: "what kind of rays yield the most favorable course of intensities," that is to say a curve with pronounced maxima and minima? The advantages of cathode rays for determining inter-molecular spacings are pointed out and the necessity of applying X-rays in certain cases of complicated molecular space lattice measurements are discussed. EF (5b)

The Application of X-Rays for Control Work in Iron and Steel (Röntgenografiens anvendbarhet för Kontroll av Järn och stal). Torkel Berglund. *Jernkontorets Annaler*, Proceedings of the Annual Meeting, May 30, 1931, Vol. 114, 1931, pages 49-85.

The principles of X-ray testing are discussed, practical arrangements are described and the advantages of non-destructive testing are demonstrated. HCD (5b)

A Comparison of the Crystal Structures of Cu_5Zn_8 and Cu_5Cd_8. A. J. Bradley. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, July 1931, page 143.

The structures of the 2 bodies are both of the γ type, with 52 atoms in the unit cell; these atoms fall into 4 groups of structurally equivalent positions, containing, respectively, 8, 8, 12, 24 atoms. In Cu_5Zn_8, the atoms cannot be distinguished by X-rays; the interatomic distances are closely the same. In Cu_5Cd_8, the scattering power of the atom is different which makes it possible to check positions and parameters better by the interatomic distances. The distances Cu-Cu are smaller than the distances Cd-Cd; the distances Cu-Cd are intermediate. 11 references. Ha (5b)

Relation of Crystal Orientation to Bending Qualities of a Rolled Zinc Alloy. Gerald Edmunds & M. L. Fuller (New Jersey Zinc Co.). *American Institute of Mining & Metallurgical Engineers, Preprint*, 1931, 11 pages.

A study of crystal orientation in low-alloy Zn sheet indicated that the crystals on the surface were orientated with the hexagonal axis perpendicular to the surface of the sheet. When the orientation peculiar to the surface layer extended to a depth of more than 0.0005 in., poor bending qualities were found. These poor bending qualities were attributed to the unfavorable orientation of possible planes of slip in the surface layer. Orientations are described by the "flächenpolifigur" of Wever. Contains 12 references. JLG (5b)

The Electronic Energy Levels of the Elements, with Special Reference to their Connection with the Sizes and Electronic States of Atoms in Metallic Crystals. Wm. Hume-Rothery. *London, Edinburgh & Dublin, Philosophical Magazine & Journal of Science*, Series 7, Vol. 11, Mar. 1931, pages 649-678.

It has been found that within an accuracy of about 1% simple relations exist between the interatomic distances in the crystals of elements and the atomic numbers and electronic quantum numbers of the atoms concerned. If Z is the atomic number, the interatomic distances vary as $1/Z$, $1/Z^2$, $1/Z^3$, and $1/Z^5$ for the elements at the beginning of the first to fourth periods. The electronic levels vary linearly with Z^2, Z^4, Z^6, and Z^{10} for electrons of the outermost group of electrons of the atomic core or ion. 7 references. Ha (5b)

X-Rays in Metallurgical Research. *Metallurgist*, Feb. 1931, pages 26-28; Mar. 1931, pages 35-36.

An extended abstract of a paper by Dr. Westgren (*Zeitschrift für Metallkunde*, Vol. 22, Nov. 1930, page 368). See *Metals & Alloys*, Vol. 2, July 1931, page 129. VVK (5b)

Practical Applications of X-Ray Diffraction Methods in the Study of Quench and Temper Structures of Carbon Steels. N. P. Goss *Transactions American Society for Steel Treating*, Vol. 19, No. 2, 1931, pages 182-192.

The author describes a study of the X-ray structures of quenched and tempered carbon tool steels. He cites the variables affecting the structure such as chemical composition, thickness and shape of the piece, quenching temperature and medium. X-rays may be used by the metallurgist to determine if a given piece has been properly quenched even after it has been tempered, and to determine the proper quenching conditions for a given job. WLC (5b)

On the Nature of the Eutectoid-Transformation of Aluminum Bronze, Part III, X-Ray Analysis, Part IV, X-Ray Analysis at High Temperatures. (In English). I. Obinata. *Memoirs of the Ryojun College of Engineering*, Vol. 3, No. 4-B, 1931, pages 285-298.

Arguing from the assumption (made by various Japanese investigators but not generally held: abstractor) that austenite always decomposes by passing through martensite, eutectoid transformation in aluminum bronze should also be a "stepped one, by the route $\alpha + \delta \rightleftarrows \beta' \rightleftarrows \beta$. An alloy with 16% Al quenched from 830° C. did not show the γ phase alleged by Stockdale to exist above 780° C., but this cannot be taken as conclusive because the change may not be suppressed by quenching. An alloy with 12.5% Al was found to contain $\alpha + \delta$ and it was decided that it would be necessary to take powder photograms at high temperature or add a third element to retard the velocity of transformation. It was assumed that Mn would exert this retarding effect, so alloys of 12.2 to 12.3% Al with 0, 1, 2½, and 5% Mn quenched in water from 850° C. The results are interpreted as indicating that without Mn, the quenched alloy consists chiefly of hexagonal β' with small amounts of β, while by adding Mn the decomposition of β to β' is retarded. On reheating the quenched alloy and again quenching it was concluded that in the Mn-free 12.5% Al alloy the change $\beta \rightarrow \beta'$ occurs between 400° and 450° C. and $\beta' \rightarrow \alpha + \delta$ at about 500° C. An alloy of 12.4% Al was subjected to X-ray analysis at a temperature not measured but estimated to be about 650° C. and was found to consist solely of β, with a body-centered cubic "super lattice," and a parameter of about 5.89 A. U. HWG (5b)

An X-Ray Investigation of the Lead-Bismuth and Tin-Bismuth Alloys. D. Solomon & W. Morris Jones. *Philosophical Magazine and Journal of Science*, Series 7, Vol. 11, May 1931, pages 1090-1103.

The method of investigation is described; the crystal structures of Pb-Bi and Sn-Bi systems are found to be different from those of the Pb-Sb and Sn-Sb systems although the crystal structures of Sb and Bi are alike. Whereas Pb easily takes Bi into solid solution, Sb is practically insoluble in Pb. Pb, however, is practically insoluble in Bi and Sb. In the Sn-Sb system a compound Sn-Sb exists having a sodium chloride structure, and solid solutions exist both at the Sn end and the Sb end of the equilibrium diagram. Contrary to it, Sn and Bi are just mixtures of the crystalline phases of the elements. 12 references. Ha (5b)

Röntgenographic Examination of Dental Gold Alloys. John S. Shell & Donald McCormack. *Journal American Dental Association*, Vol. 18, Aug. 1931, pages 2193-2194.

Discusses the desirability of this method of non-destructive testing and reports the results of tests on a cast specimen 0.02 in. thick, 0.25 in. wide, and 3 in. long and on a cast "saddle" with 4 clasps. A casting 0.04 in. thick was also examined. The results were reported as encouraging for this type of testing. OEH (5b)

Atom Arrangement and Properties in $Au\text{-}Cu_3$ (Atomordnung und Eigenschaften, Untersuchungen an der Legierung $Au\text{-}Cu_3$). G. Sachs & J. Weerts. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 17, 1931, pages 45-48; *Zeitschrift für Physik*, Vol. 67, Feb. 6, 1931, pages 507-515. 6 figures, 14 references.

The Au-Cu solid solution corresponding to the composition $Au\text{-}Cu_3$ has irregularly distributed atoms at high temperature, but on slow cooling, the atoms take up a more regular lattice position without reaching a regular face-centered lattice arrangement. The behavior may be analogous to the β' to β brass and the α to β iron changes. An alloy of 50.9% Au was studied by X-ray methods. Quenched from 800° C., the lattice spacing was 3.755 A.U.; after annealing at 345° C. for 10 days, 3.751. The electrical resistivity, the elastic modulus, the ductility and the crystal orientation on stretching, were studied. The results are interpreted to indicate that the change of structure is in the direction of producing properties analogous to those of a pure metal. HWG (5b)

Studies on Magnesium and Magnesium Alloys. (Studien an Magnesium und Magnesiumlegierungen.) E. Schiebold & G. Siebel. *Zeitschrift für Physik*, Vol. 69, May 28, 1931, pages 458-482.

See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 36. JGT (5b)

X-Ray Examination of Electroplated Chromium Coatings. W. A. Wood. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, Oct. 1931, pages 853-864.

The conditions of obtaining a certain kind of deposit and the metallurgical characteristics of these conditions are investigated and formulas are developed for the calculation of the grain size and its variation with current and temperature. The existence of a hexagonal chromium, beside the normal body-centered cubic form of chromium, obtainable by electro-deposition, is confirmed. Electrolytically deposited chromium gives very broad X-ray diffraction lines; this is attributed to the very finely divided nature of the deposit. Ha (5b)

Guaranteed by X-ray Inspection. W. H. Shipman (Babcock & Wilcox Co.). *American Machinist*, Vol. 75, Nov. 5, 1931, pages 708-709.

The Barberton plant of the Babcock & Wilcox Co. inspects all longitudinal and girth seams of all pressure vessels. Costs are not prohibitive. Defects revealed include: (1) poor penetration or improper fusion at the scarfs between the weld and the parent metal; (2) laps that are not fused; (3) gas pockets; (4) shrinkage cracks. The Coolidge tube is used with the X-ray apparatus. RHP (5b)

The Relation Between Uranium and Radium. Part 9. The Period of Ionium. Frederick Soddy. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, Nov. 1931, pages 939-945.

Earlier parts are identified in the article. The one preceding this, Part 8, appeared in the *Philosophical Magazine*, Series 6, Vol. 47, 1924, pages 1148-1158. Highly theoretical discussion of experimental work on the determination of the period of ionium. Values are lower than those obtained by Stefan Meyer and Mmes. Curie and Cotelle. RHP (5b)

Hyperfine Structure of Mercury. Kiyoshi Murakawa. *Scientific Papers Institute of Physical & Chemical Research* No. 326-327, Vol. 16, Sept. 1931, pages 243-255.

A new description of the hyperfine structure and the Paschen-Back effect of the Hg-line λ = 4046.56 (6^3Po — 7^3Si) is given. The Paschen-Back effect determines uniquely the nuclear moment of all the Hg isotopes: I = 0 for even isotopes; I = ½ for Hg_{199}; I = 3/2 for Hg_{201}. The relative shift of even isotopes in the terms 6^1S_0, 7^3S_1, 7^1S_0 is given. Ha (5b)

Growth of Metallic Crystals in Metal Vapor (Das Wachstum von Metallkristallen in Metalldampf). M. Straumanis (University of Riga). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 13, Aug. 1931 pages 316-337.

The condensation of Zn and Cd vapor on glass walls in vacuo also takes place if the temperature of the walls is higher than the melting point of the metals if a sufficiently great density of the beam is secured over a certain length of time. Nuclei having been formed, those grow most rapidly to large crystals which are at a temperature slightly higher than the melting point of the metal evaporated. Under a certain limit of temperature (Zn: 375° C.), the crystal growth is strongly checked and the metal is precipitated in fine crystalline powder. A nucleus continues to grow along the diagonal axis of second order, so that the formation of large hexagonal crystal plates limited by parallel base faces takes place. The separation of new lattice planes always starts from the center of the base face. The horizontal growth is stopped after some atom-distances from the edge of the plane beneath; this occurrence is in agreement with the theory of homopolar growth of crystal. Consequently crystals develop into pyramids of the I Order with a truncated face. The boundry faces met with on Cd are (0001), $(20\bar{2}5)$, $(10\bar{1}2)$ and $(20\bar{2}3)$ and in the case of Zn: (0001), $(10\bar{1}1)$, $(20\bar{2}3)$ and $(40\bar{4}1)$. Prism planes are very seldom encountered in either of the metals investigated. The pyramids are built up in the form of terraces and the thickness of the individual plates amounts to 0.8 ± 0.1 μ or a multiple number thereof in the case of Cd. The evaporation proved to take place in an arranged manner too, and disclosed the reversed order of the condensation process outlined above. The investigators set forth interpretations of their observations on the crystal growth of Zn and Cd on the basis of the theory of Kossel and Stranski. EF (5b)

Registration of Cathode Rays by Thin Films of Metals and Metal Compounds. Warren W. Nicholas & C. G. Malmberg. *Bureau of Standards Journal of Research*, Vol. 8, Jan. 1932, pages 61-65.

A search was made for a method of registering cathode rays analogous to the photographic method which could be carried out entirely in daylight and in which no development process would be required. For this purpose thin metal films (Pb, Ag, Bi, Sn, Cd, As, Cu, Sb, Zn, Mg, Se) were deposited on glass by evaporation from a coiled tungsten filament in vacuum. These were then exposed, in vacuum, to a beam of 10 kv cathode rays. Films of Pb and Sn so thin as to be quite transparent before exposure, were darkened to a density of the order of 0.5 by exposure to 0.01 coulomb/cm.² Also opaque films of the above metals were exposed to the vapors of various acids (HCl, HNO_3, HBr, HI, H_2S, H_2SO_4); this generally produced a lowered opacity, in many cases the films becoming transparent. Exposure to cathode rays tended to restore the original opacity. In general, the best effects were obtained with nitrates and bromides; $Bi(NO_3)_3$ seemed to show the most promise as to sensitivity and permanence of the record. The cathode ray bombardment caused practically all the films to fluoresce, the color and intensity of the fluorescence depending on the material. WAT (5b)

X-Ray Investigation on the Hydrides of Titanium, Zirconium, Vanadium and Tantalum (Röntgenuntersuchung über die Hydride von Titan, Zirkon, Vanadin und Tantal). G. Hägg (University of Stockholm). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. XI, Feb. 1931, pages 433-454.

Several hydride phases of Ti, Zr and Ta were found, all showing a rather simple atomic arrangement. Due to inhomogeneities, experiments with V did not yield useful photograms worthy of interpretation. The radius of the hydrogen atom gave an average value of 0.46 A.U. The ranges of homogeneity of the Ti-H, Zr-H and Ta-H systems are schematically presented. EF (5b)

Supplementary Remark to the Paper "Crystallographic Structure of Fe_2B". (Berichtigung zu der Arbeit "Kristallbau der Verbindung Fe_2B"). G. Hägg (University of Stockholm). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 12, June 1931, pages 413-414.

The structural arrangement of Fe_2B becomes a higher symmetry as previously stated (*Zeitschrift für physikalische Chemie*, Sect. B, Vol. 11, No. 2/3, pages 152-162) if the vertical parameter of the Fe-atom amounts to exactly 1/4. The analogy between the Fe_2B structure and the $CuAl_2$ structure is pointed out. EF (5b)

Interferometric Measurements in the Arc Spectrum of Iron. C. V. Jackson. *Proceedings Royal Society*, Vol. A130, 1931, pages 395-410.

Interferometric measurements were made of 10 lines in the Fe arc spectrum between 4000 and 4400 A.U. by comparison with the red Cd line and the secondary Ne standards. Measurements have also been made of 68 lines between 2300 and 3100 A.U. in the Fe arc and 5 lines in Hg from 2652 to 3125 A.U. The results are in good agreement with other investigators and with calculated results obtained from energy levels. WAT (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Brinell Ball Hardness Tests. MICHITOSHI ICHIHARA. *Technical Reports Tohoku Imperial University,* Vol. 10, No. 1, 1931, pages 25-41.

Cross-sectional curves of the indentation made by a Brinell ball were measured by means of an optical lever arrangement for such materials as low C steel, mild steel, Cu, cast Fe, Sn, Zn, bronze and Al. An empirical formula is given for these curves, which is claimed to be applicable to all the metals mentioned with an error of less than 2/1000 mm. (6)

New Studies on the Nature of Abrasion. Correspondence from S. SAITO, Osaka, Japan. *Metal Progress,* Vol. 21, Feb. 1932, pages 70 and 90.

The writer describes certain abrasion tests and his explanation of the mechanism of abrasion is presented. WLC (6)

Cracking of Reinforcing Bars at Cold Bends. TH. WYSS (Federal Testing Laboratory, Zurich, Switzerland). *Civil Engineering,* Vol. 1, Nov. 1931, pages 1266-1268.

At the first International Congress on Concrete and Reinforced Concrete, held in September 1930, at Liege, Belgium, the author presented a brief paper giving a simple but effective explanation of an embrittling phenomenon which occurs under certain conditions in ductile steel, in particular at the concave side of cold bends made in reinforcing bars. The steel on the inside of the bend undergoes plastic deformation in compression, which may be so great that when the bending forces are relieved the residual internal tensile stresses developed by the cold bending may result in the formation of a crack on the inside of the bend. It was shown that after ductile steel has been plastically deformed in compression 20% or more it becomes extremely brittle when subsequently subjected to tensile loads. This embrittling phenomenon may explain some of the perplexing cases of failure where a very ductile steel part has broken in service as if the material in it were devoid of all ductility and under conditions where the break cannot be attributed to the fatigue of the metal. WAT (6)

Shear Tests for Cast Iron. H. H. JUDSON. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 304-316.

Includes discussion. Shear specimens cut from actual castings, a boss being cast solid and the specimen trepanned from it, show correlation of single shear strength and bursting strength of the pump cylinder castings from which they were cut. At 1000 lbs. bursting strength the shear strength was 15,000 lbs./in.^{2}, rising almost linearly to 43,000 lbs./in.^{2} at 4000 lbs. bursting strength, then the curve breaks, but is again almost linear to 55,000 lbs./in.^{2} at 6500 lbs. bursting strength. The shear strength is from 1.10 to 1.15 times the tensile strength, both determined on parts of actual castings. The practical control afforded by tests of the casting itself through small trepanned shear specimens is better than with separately cast test bars. In discussion, J. Shaw pointed out that poor material may pass the shear test that would not pass other tests. Bornstein and MacKenzie thought that a test bar designed to have the same cooling rate as the casting would be preferable. Capp approved the idea of determining the properties of the casting itself. MacPherran thought the test might be useful. HWG (6)

A Comparative Study of Some Properties of Pig-Irons. J. E. HURST. *Foundry Trade Journal,* Vol. 45, Nov. 26, 1931, pages 337-339.

A paper accompanied by 4 tables and 3 diagrams, showing the stress deflection curves for 3 different classes of iron. It discusses the ultimate breaking strength, the stress deflection curves, and the modulus of elasticity, pointing out that the ultimate breaking strength alone is insufficient as a measure of the toughness of cast iron, whereas the area included by the stress-strain curve is a very close measure of this property. This, however, is insufficient, and attention needs to be directed to the character of the deformation sustained during load and to the shape of the curve. The transverse test, as ordinarily carried out, including the measurement of total deflection, is only a partial guide to toughness in view of the fact that it gives no record whatever of such phenomena as have been described above. OWE (6)

Using Elongation Measurements in Practice. (Der Nutzen von Dehnungsmessungen in der Praxis.) JOSEPH GEIGER. *Maschinenbau,* Vol. 10, Dec. 3, 1931, pages 709-710.

Discusses the impossibility of calculating strains which develop in objects, and how they are supposedly measured, considering specifically the observed values in stationary elongation tests. The results, if accurate, are of prime importance in machine parts (such as piston rods, driving rods, and crankshafts). Describes dynamic elongation tests. MAB (6)

Supplementary Methods of Stress Analysis. HERBERT J. GILKEY & ELMER O. BERGMAN. *Civil Engineering,* Vol. 2, Feb. 1932, pages 97-101.

Mathematical solutions of the stresses in simple engineering structures can be made with reasonable exactness, but a full theoretical analysis of the complex stresses in intricate structures is only possible in a few special cases. Experimental methods must be resorted to, such as the use of strain gages, the testing of models made of various materials, the method of analogy, the study of yield lines on the surface of members stressed to the elastic limit, or the examination of photo-elastic images produced by passing polarized light through stressed models. Good judgment is required in choosing the proper experimental method for verifying or checking the mathematical analysis used. These various experimental methods for attacking complicated problems of stress distribution are discussed. The testing of steel beams to be used in the Delaware River Bridge and the formation of stress lines thereon is described and illustrated. A number of reproductions of images of photo-elastic examinations of beams under various conditions of loading are also presented. The use of models in the study of stresses in large dams such as the Stevenson Creek, Gibson, and Hoover is also dealt with. A selected bibliography is given. WAT (6)

The Unbalanced Alternating Current Bridge for Magnetic Analysis II. W. B. Kouwenhoven & J. H. Lampe. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 107-128.

Includes discussion. See abstract of preprint, *Metals & Alloys,* Vol. 2, Nov. 1931, page 255. HWG (6)

Report on Wear Tests on the Amsler-Machine. Influence of the Reciprocal Motion of the Test Roll (Bericht über Verschleissprüfungen auf der Amsler-Maschine. Einfluss der Hin- und Herbewegung der Versuchsrolle). Mehovar. *Zwanglose Mitteilungen der deutschen und oesterreichischen Verband für Materialprüfungen der Technik,* No. 19, Sept. 1930, pages 262-263.

If the test roll was given an axial movement of 2-3 mm., the normal wear was increased 2-3 times and the dispersion from ±0.6% to about ±20%. Ha (6)

A Simple Method of Studying the Stress-Strain Relation in the Notched-Bar Impact Test. Tadashi Kawai. *Science Reports, Tohoku Imperial University,* Series I, Vol. 19, 1931, pages 727-743.

By the ordinary method of applying the notched-bar impact test, the value of the impact energy required which is just sufficient to break the test piece, is found, but not the stress-strain relation. Though the impact value is a measure of the toughness of metals, it does not give any information as to the behavior of the metals under load, as is obtained by the statistical test. Hence, the present writer has devised a simple method for determining the energy-strain and stress-strain relation in notched-bar impact test, by using an ordinary Charpy machine. (6)

The Determination of the Static Bending Stresses in Laminated Springs (Ueber die Ermittlung der statischen Biegespannungen in geschichteten Federn). *Automobiltechnische Zeitschrift,* Vol. 34, Nov. 30, 1931, pages 751-756.

The object of this investigation is to determine from the measured deformation of the layers of the spring the forces occurring between the individual leaves which are themselves unknown and to calculate from this the actual bending stresses in the individual laminae of the spring. This calculation is carried out for the laminated spring, loaded and not loaded. A formula is developed for the calculation of the forces which are transmitted at the ends of a leaf to the next one on top of it. The method of calculation is illustrated by an example. Ha (6)

Measurement of Stresses in Billets Quenched on one Side. (Spannungsmessungen an einseitig abgeschreckten Knüppeln.) F. Stäblein. *Stahl und Eisen,* Vol. 52, Jan. 7, 1932, pages 15-17.

The paper corresponds to the publication in *Krupp'sche Monatshefte,* Vol. 12, May 1931, pages 93-99 as abstracted in *Metals & Alloys,* Vol. 2, Nov. 1931, page 255. GN+DTR (6)

Six Methods now in Use for Non-destructive Weld Tests. *Steel,* Vol. 89, Dec. 14, 1931, pages 34-35.

A brief discussion of the principle of these methods; hydrostatic pressure test, air pressure test, low pressure test, reheating test, stethoscope test, and X-ray test. Ha (6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Unequal Loading Decreases Elevator Rope Life. A. S. Rarden (American Cable Co.). *Power,* Vol. 74, Nov. 10, 1931, pages 683-684.

The fatigue life of the outer wires of the strands next to the core is proportionately increased as compared to the fatigue life of the outer wires on the outer strand crowns with increased loads on the rope. AHE (6f)

Corrosion-Fatigue Tests of Mild Steel and Chromium-Nickel Austenitic Steel in River Tees Water. N. P. Inglis & C. F. Lake. *Transactions Faraday Society,* Vol. 27, Dec. 1931, pages 803-808.

The following gives results obtained in rotating beam type fatigue testing machines with River Tees water dripping on the specimen. Analysis of water is, per 100,000 parts, total solids 2954, lime 48, magnesia 164, SO_3 176, $Fe_2O_3 + Al_2O_3$ 0.4, chlorine as Cl 1441.0.

Material	Fatigue Limit in air tons/in.²	Corrosion Fatigue Limit in River Tees Water tons/in.²
Mild Steel (0.2% C) normalized from 900° C.	±17.0	Nil.
18/8/1 (17-19 Cr, 8-10 Ni, 0.6-1.0 W, C < 0.16) ¾" bar heated to 1100°-1150° C. and water quenched	±17.6	±11.1
The same steel but drawn at 650° C. for 8 hrs. and air cooled	probably same	±6.5

The fracture was shown to be predominantly transcrystalline in corrosion fatigue failures. It is suggested that the effect of repetitions of stress is to cause a continual breaking down of surface passive film, favoring pit formation which may take the form of minute intercrystalline fissures. When the resultant intensification of stress is greater than fatigue limit failure proceeds by ordinary fatigue. PRK (6f)

A Few Remarks on the Choice of Residual Loading of Material. (Einige Bermerkungen über die Wahl der zulässigen Anstrengung der Werkstoffe.) Otto Graf. *Maschinenbau,* Vol. 10, Feb. 5, 1931, pages 84-85.

The paper discusses recent tests on the endurance strength of steels, particularly of rolls and borings. MAB (6f)

Endurance Properties of Some Well-Known Steels in Steam. T. S. Fuller. *American Society for Steel Treating, Transactions,* Vol. 19, No. 2, 1931, pages 97-114.

Discussion. Previously abstracted as Preprint No. 8, 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 306. WLC (6f)

Endurance Testing of Steel: Comparison of Results Obtained with Rotating Beam versus Axially Loaded Specimens. R. D. France. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 176-193.

After a complete overhauling of 2 Haigh tension-compression fatigue machines so as to fit them for precise work and insure axial loading, 14 ferrous materials were compared at the Bureau of Standards in axial loading and in rotary beam (R. R. Moore machine) tests. The specimens were aligned with the most scrupulous care to insure axial loading. Materials tested were open hearth iron, wrought iron and steels of 0.45 to 0.87% C including rail steels. Rotating beam results were always higher than those by axial loading. Annealed steels showed a much lower ratio of axial to rotary beam endurance limit than they did after oil quenching and tempering at 1000° F. or over. The ratios for the materials tested varied from 74% to over 99%. The more homogeneous the material the higher the ratio. Includes discussion. HWG (6f)

The Influence of Holes on the Endurance Limit of Steel Specimens (Der Einfluss von Bohrungen auf die Dauerfestigkeit von Stahlstäben). G. Barner. VDI-Verlag, Berlin, 1931. Paper, 6 x 8¼ inches, 50 pages. Price 5.50 RM.

The effect of notches upon stress-concentration is first discussed and data tabulated from the literature to show the effect of various types of notches on the endurance limits of various alloys. Rotating beam endurance tests were carried to 10 million cycles and axial loading tests (on an Amsler tensile machine with pulsator) to 2 million cycles. The rotating beam specimen was 7.52 mm. in diameter, tested (a) polished, (b) with a 0.7 mm. hole bored normal to the axis, (c) with a 60° V notch 0.2 mm. deep cut all around the specimen. The Amsler specimens were 10 to 22 mm. wide, 15 to 18 mm. thick, tested either without a hole or with a 1 mm. hole bored in the middle of the test length. The Amsler specimens were made 4 in series of widths of 10, 14, 17 and 22 mm. so that when the smallest one broke, the next could be regripped and the test continued. 3 steels were tested. (a) Hard structural steel (micrograph shows high carbon) 85,000 lbs./in.² tensile 53,500 yield, 22½% elongation, 52% reduction. (b) Soft structure steel 58,500 tensile, 35,500 yield, 29% elongation, 63% reduction. (c) Alloy structural steel (composition not given) 74,000 tensile, 47,000 yield, 27% elongation, 60% reduction. In rotary bending, (a) gave, polished, 45,000 lbs./in.²; bored (hole smoothly finished) 24,000 lbs./in.²; notched 31,000 lbs./in.² endurance limit. On the Amsler test between minimum and maximum tension stresses such that the maximum was 4 times the minimum, steel (a) gave 59,000 lbs./in.² machined; 55,000 lbs./in.² with rolling skin; 42,500 lbs./in.² with smooth hole; 35,500 lbs./in.² with rough hole. Steel (b) gave, with rolling skin 42,500 lbs./in.²; with rough hole 32,500 lbs./in.². Steel (c) gave with rolling skin 39,000 lbs./in.²; with rough hole 30,000 lbs./in.². The rolling skin on (c) has microscopic cracks.

H. W. Gillett (6f)-B-

ELECTRO-CHEMISTRY (7)

The Electrolytic Solution Tension and the Necessity of Taking into Account the Galvanic Potential Metal/Metal in the Galvanic Chain. (Ueber die elektrolytische Lösungstension und die notwendige Mitberücksichtigung des Galvanipotentials Metall/Metall in der Galvanischen Kette.) H. Hammerschmidt & E. Lange. *Physikalische Zeitschrift,* Vol. 32, Dec. 1, 1931, pages 958-964.

The problem of the electrolytic solution tension is complicated due to the phenomenon of a galvanic potential between 2 metals, which has not always been properly accounted for. A partial analogy between the ordinary 2 phase system (electro-neutral solid phase—saturated solution) and the electro-chemical binary system is pointed out with reference to the ideal zero concentration and the ideal solution tension which represents a normal measure for the energy occurring during the transition of an ion from the solid phase into the attraction forces of a solution. The concentration due to the dipole participation on the building up of the electrolytic double layer does not coincide with the ion absorption deciding the potential. In the second place this concentration does not coincide with the zero point of the accompanying volta potential due to the occurrence of the surface potential of the pure faces. Neither zero point offers a possibility of determining the ideal zero point concentrations of the solution tensions. In addition to that 2 ideal zero electrodes combined in a galvanic chain would not yield any clues in regard to the e.m.f. The data found in literature on the true zero point concentration and on the true solution tension neither furnish any information on the absolute and relative value of the galvanic potential of a single electrode nor on the normal ion transition energy, but only give the e.m.f. of certain galvanic cells. The author recommends paying regard to the galvanic potential metal/metal in order to exclude false conclusions in electrochemistry.
EF (7)

Transference Potentials and Transference Numbers in Metallic Solutions (Ueberführungspotentiale und Ueberführungszahlen in metallischen Lösungen). K. Schwarz (University of Vienna). *Zeitschrift für physikalische Chemie,* Sect. A, Vol. 154, Sept. 1931, pages 227-231.

Data from experiments with the amalgams of Zr, Ta, Sn, Bi, Au and Pb.
EF (7)

Role of Hydrogen in the Dissolution of Iron (Bemerkung über die Rolle des Wasserstoffs bei der Auflösung des Eisens). H. Cassel & T. Erdey Gruz. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 156, Oct. 1931, pages 317-318; reply, E. Liebreich, pages 319-320.

Differences which have been observed when dissolving Fe in aqueous electrolytes under exclusion of O are explained by differences in the H potential. This view is not accepted by Liebreich. (*Zeitschrift für physikalische Chemie,* Vol. 155, July 1931, pages 123-142).
Ha (7)

Temperature Compensation in Electrolytes (Temperaturkompensation bei Elektrolyten). E. Blamberg & K. Müller. *Archiv für Elektrotechnik,* Vol. 23, No. 4, 1930, pages 435-440.

The fact that the condition of an electrolytic cell varies rapidly with temperature as well as with concentration may be a disadvantage in some processes of deposition. The authors show how to proportion a combined shunt manganin resistance and a series Cu resistance to compensate substantially for the effect of temperature.
Ha (7)

On the Undefined Potentials Metal Solution and Their Evaluation with Respect to the Electro-Chemical Deposition of Radio-Elements (Ueber undefinierte Potentiale Metall Lösung und ihre Auswertung zur elektrochemischen Abscheidung von Radioelementen). O. Erbacher (Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem). *Zeitschrift für physikalische Chemie,* Sect. A, Vol. 156, Sept. 1931, pages 135-141.

The undefined potentials of various metals against an 0.1 N HCl solution at 20° and 79° C. were determined and compared with the deposition potentials of certain radioelements (polonium on silver, radium E on nickel). Derivations are made in regard to the electrochemical phenomena encountered in the electrochemical methods of radio-chemistry.
EF (7)

Electroplating (7a)

Nickel and Chromium Plating at High Current Density. *Brass World,* Vol. 27, Sept. 1931, pages 199-200.

The greatest problem of Cr plating has been the securing of satisfactory adhesion of the Ni undercoat. Problems peculiar to high current density may be grouped as follows: (1) the inclusion of foreign matter in the deposit, due to necessary vigorous agitation; (2) the difficulty of securing adequate deposits on recessed surfaces owing to low throwing power; (3) variations in thickness of deposits due to contact resistance, excessive current density at the bottom of the articles and to screening effects. The Ni plating, Ni mopping, and Cr plating are discussed. High current density Cr plating solutions have maximum throwing powers.
WHB (7a)

Chrome-Plating of Brass and Alpaca. (Das Verchromen von Messing und Alpaka.) Karl Schuch. *Oberflächentechnik,* Vol. 8, Dec. 15, 1931, pages 255-256.

The best practice for chrome plating of brass is now considered to be using an intermediate layer of Ni which should contain as little hydrogen as possible and should be soft; the Cr layer need then be only very thin and serves as hardener. The following Ni bath is recommended: 100 L. water, 10 kg. nickel sulphate, 1.5 kg. sodium citrate, 1 kg. sodium sulphate, 0.8-1.0 kg. boric acid, 0.25 g. citric acid; the gravity is 10-12° Bé., the bath temperature 35 to 40° C., the acidity should be between 5.2 and 5.9 pH; the voltage is 3-3.25 volts, and the current density 0.8-1.0 amp./dm.^{2} Alpaca is greatly used in the cutlery industry. Chrome-plating is here recommended instead of silver plating as the former does not tarnish as easily as silver. The pieces must be well polished before chrome-plating. Detailed information is given for the treatment, degreasing and subsequent cleaning.
Ha (7a)

The Analysis of Cyanide Silver-Plating Solutions. R. M. Wick. *Bureau of Standards Journal of Research,* Vol. 7, Nov. 1931, pages 913-933.

Methods for the analysis of cyanide silver-plating solutions were studied, including the determination of free cyanide, total cyanide, carbonate, chloride, ammonia, Ag, Fe, Cu and Hg. Electrometric titrations showed that the Liebig method for alkali cyanide is correct to better than 0.2%. Addition of KI make the method still more accurate and overcomes the effects of impurities on the titration. The non-agreement of the Liebig and Hannay methods was studied by electrometric titrations, which showed that the visual Hannay method gives high results although the electrometric Hannay titration is accurate. The determination of the total cyanide was accomplished by distillation with sulphuric acid and of total effective cyanide by titration with I. Ag may be separated as silver sulphide, by precipitation with Zn, or by decomposition with acid, after which a determination by any standard method is applicable. Carbonate may be determined by precipitating and filtering out barium carbonate and titrating it with acid or by titrating a sample with acid after adding silver nitrate to combine with the free cyanide. The usual method for the determination of chloride involves prolonged treatment with nitric acid, which converts the precipitated silver cyanide to silver chloride. A new method for separating chloride was investigated in which the Ag was precipitated as sulphide and the iron is removed by precipitation as manganous ferrocyanide. The chloride in the filtrate can be determined by the usual methods. Fe and Cu can be determined by the usual analytical methods after decomposition of the plating solution with sulphuric acid. Hg can be determined by precipitation as sulphide along with silver sulphide. The mercuric sulphide is extracted from the mixed sulphide precipitate with sodium hydroxide, reprecipitated and weighed. A new method was developed for the determination of ammonia in cyanide solutions, in which the free cyanide is converted to the Ag complex preparatory to the usual distillation. Direct distillation is not satisfactory because ammonia is formed by decomposition of alkali cyanide at elevated temperatures.
WAT (7a)

Electrometallurgy (7b)

The Electrolytic Refining of Tin at the Mitsubishi Osaka Refinery. Z. Kimura. *Journal Mining Institute of Japan,* Vol. 47, No. 558, 1931, pages 966-1001.

The electrolytic refining of the crude tin obtained in the reverberatory furnace of the Ikuno Mine dates from 1916. Since the plant was removed to the Mitsubishi Osaka Refinery in 1920, the author has developed it into the present one which produces more than 80 tons/mo. Systematic studies to find the best composition of the electrolyte are described in this report. The chief factors studied were the dissolution of the anode, the state of the anode slime, the effects of hydrolysis and the purity of the cathodic deposit. The composition of the crude tin from the Ikuno mine is as follows: 90-96% Sn, 2-5% Cu, 0.3-0.7% Pb, 0.3-0.6% Bi, 0.07-0.21% Fe, 0.4-0.6% As, 0.5-0.6% Sb. The elimination of Cu was considered principally in this case. The plain sulphuric acid bath is inapplicable owing to the hydrolysis of Sn, and the addition of NaF, HCl, some sulphates and cresol sulphonic acid did not bring satisfactory results. Although the hydrofluosilicic acid bath which has long been used in the plant is excellent, its cost is rather high and the author tried to replace some portion of the acid with H_2SO_4. The rate of diminution of the stannous ion concentration during electrolysis was more affected by increase in temperature than by that in the H_2SO_4 concentration. The electrolyte containing 5.6% H_2SiF_6 and 6% H_2SO_4 may satisfactorily be applied to the anode with the purity of 95.4% at 18° C. and even to the 90% one if the current be reduced to 0.4 A/dm.^{2} As the presence of H_2SiF_6 has been found to be necessary only for preventing the hydrolysis of tin salts, its concentration is now being progressively reduced in practice. The cresol sulphonic acid bath with the strength of 16% (including the uncombined H_2SO_4) was good above 30° C. but its weak points are the high cost and the low current density required. Although the concentration of the acid can be reduced by adding some H_2SiF_6, much value can not be set upon it as the simple H_2SiF_6 and H_2SO_4 mixture was sufficient.
YO (7b)

Examples of Hydrometallurgical and Electrometallurgical Operations. III. Refining of Gold and Silver. Thomas P. Campbell. *Colorado School of Mines Magazine,* Vol. 21, No. 8, Aug. 1931, pages 11-16.

In acid parting, hot concentrated H_2SO_4 is replacing HNO_3. Acid parting operations may be outlined as: (1) blending of the bullion and preparation for parting; (2) dissolution of Ag and base metals; (3) treatment of the residues for Au; (4) treatment of the solution for Ag. The Moebius and Balbach refining processes for Ag and the Wohlwill process for Au are described.
WHB (7b)

Copper-Electrolysis of the Zinnwerke Wilhelmsburg G. m. b. H. (Die Kupferelektrolyse der Zinnwerke Wilhelmsburg G. m. b. H. zu Hartburg-Wilhelmsburg bei Hamburg.) Georg Eger. *Siemens-Zeitschrift,* Vol. 11, Dec. 1931, pages 537-541.

A general description of the electrolytic refining process is given; the works' equipment and installations for an output of 50 tons per day is described in detail.
Ha (7b)

Manufacture of Aluminum by Electrolysis. *Journal Society Chemical Industry,* Vol. 50, Feb. 6, 1931, page 121.

The bath comprises a mixture of aluminum fluoride and sodium or potassium carbonate in the molecular ratio 4 : 5 instead of cryolite. On fusion, this mixture yields a solution of alumina in cryolite.
(7b)

Electrodeposition of Metals from Anhydrous Ammonia. Harold Simmons Booth & Menahem Merlub-Sobel. *Journal of Physical Chemistry,* Vol. 35, Nov. 1931, pages 3303-3321.

The authors show that many metals can be deposited cathodically from anhydrous ammonia solutions of their salts in compact adherent form. Bi cannot be so deposited. Be, which is not deposited from aqueous electrolytes, can be deposited from ammonia. A description is given of a cell which has been designed for high-pressure electro-deposition studies.
OWE (7b)

INDUSTRIAL USES AND APPLICATIONS (9)

Beryllium Alloys Improve Springs. *Scientific American*, Vol. 146, Jan. 1932, page 58.

The properties of Be have been exploited in the manufacture of springs which retain their elasticity even at a red heat. Ferrous alloys containing 1% Be, 12% Cr and more than 8% Ni are used. Compared with the best W special steels with high creep limit, these Be steels have a temperature advantage of 50°-100° C. WAT (9)

Cupro Nickel Condenser Tubes (Los Tubos De Condensadores En Cuproniquel). *Revista Minera*, No. 3248, Jan. 1932, page 32.

Cu-Ni alloy (70:30) or monel metal gives best results for fabrication of condenser tubes. It is far more resistant than formerly used copper-brass (70:30), with or without Sn. Such tubes cost more than brass tubes but have longer life and higher scrap value. Mechanical properties are superior, which permits decreasing thickness; "season cracking" resisted. Conductibility in c. g. s. units; Cu-Ni, 0.07; monel metal, 0.06; brass, 0.24. DTR (9)

Round Table Discussion on Cast Iron Pipe. *Water Works Engineering*, Vol. 84, July 15, 1931, page 1011.

On the question "Do you favor cast iron pipe made in 12, 16 or 18-foot lengths? Why?" the tabulated replies from water works superintendents were as follows: 14 favored 12-ft. lengths; 17, the 16-ft. lengths; 9, the 18; and one the 24-ft. length. CBJ (9)

Bolts, Screws and Nuts, Materials and Manufacture. Recommended Practice Committee, A. S. S. T. *Metal Progress*, Vol. 20, Nov. 1931, pages 66-68.

Recommended steels, manufacturing operations and heat treatment for these parts are discussed. WLC (9)

Lead Covered Cable. *Wire & Wire Products*, Vol. 6, Oct. 1931, pages 402-404.

A general description of types and uses of lead cables. The properties of the cable sheath metal are discussed; it must be easily pliable and have a tensile strength of at least 4000 lbs./in.^{2}. Pure Pb is usually used for power cables; an alloy with 1% Sb has given good service. Recently, a Pb-Ca alloy with 0.03-0.04% Ca cooled from an extrusion temperature of 225°-250° C. has been developed which is said to be of excellent quality. The lengths of cable, especially of heavy power cables, are made so as to fit the particular use without having to cut it. Ha (9)

Copper Ground Rod Has Steel Core. *Electrical World*, Vol. 98, Oct. 3, 1931, page 628.

The Bridgeport Brass Co. has marketed a Cu ground rod with heavy Cu exterior securely bonded to a rigid steel core. The Cu as applied will not fold, slip, wrinkle nor pull loose during driving and it defies the moisture and corrosive action of the soil. The rods are available in standard sizes. WHB (9)

Recent Developments in Poppet Valves. *S. A. E. Journal*, Vol. 29, Nov. 1931, pages 404-405.

A discussion of A. T. Colwell's paper which appeared in the July *Journal of the S. A. E.* Discussers of this paper submit experiences with various types of valve seat materials which are used in aeronautic and other types of engines. Valves of the motor coach engines are said to operate under harder conditions than those of aircraft engines. Excessive heat is given as a cause of pick-up from the valve seats and even from valve stem guides. A hope is voiced for a steel that is suitable for valves which will have thermal conductivity as good as that of ordinary C steel. WAT (9)

Opportunities in Architecture. *American Machinist*, Vol. 74, Jan. 1, 1931, pages 2-5.

Briefly reviews the history of building. Discusses the use of metal in building, some all metal buildings already built and the probable field for the all metal buildings. Does not consider building methods. RHP (9)

First Stainless Steel, Shot Welded Airplane Tested. *U. S. Air Service*, Vol. 16, Dec. 1931, page 48; *Aero Digest*, Vol. 19, Dec. 1931, page 60.

Test flights were recently completed on an amphibian employing a new type of metal construction. Designed by the American Aeronautical Corp., this new airship is of "shot welded" stainless steel. It was built after several years of research and experiment by the metallurgists and welding technicians of the Edward G. Budd Mfg. Co. in collaboration with the designers, under the direction of Enea Bossi, who acquired the second flying license issued by the Italian government more than 20 years ago. According to the builders, extensive tests have shown that stainless steel has less bulk than duralumin, being from 6-8% lighter than dural, and from 10-14% lighter than wood. WAT (9)

Why—Where—How to Sell Steel Ceilings. *Sheet Metal Worker*, Vol. 22, July 10, 1931, pages 404-406.

Notes the great possibility, especially in existing buildings, of replacing ceilings and walls by steel sheeting. A more pleasing job is often obtained at a saving in price. Ha (9)

The All-Welded Dwelling House. *Sheet Metal Worker*, Vol. 22, Sept. 4, 1931, pages 523-524.

A detailed and illustrated description of a 2 story house 32 x 26 ft., basement and garage. Ha (9)

Electric Line Installs High-Speed Aluminum Cars. *Railway Mechanical Engineer*, Vol. 105, Sept. 1931, pages 437-439, 448.

Describes manufacture of a car of 46 ft. over all length, 50,000 lbs. light weight. Aluminum alloys are used in the construction of frames and body, air brake and other equipment. A saving of 40,000 lbs. was effected in the light weight. Ha (9)

Steel Houses of Germany and France are Mostly Small. Thomas J. Foster (National Bridge Works). *Iron Age*, Vol. 128, Sept. 3, 1931, pages 623-625.

Fifth installment dealing with the use of steel in the building of private homes. Large amounts of Cu bearing steel sheets or light plates have been used. Ingenious methods of construction have been developed in both France and Germany. VSP (9)

Steel Tubes with Cast Alloy Linings. *Power*, Vol. 73, June 23, 1931, page 1008.

Steel tubing lined with a variety of metals or alloys in which the bonding of the 2 metals by fusion is said to be so complete that there is no evidence of separation and no manual means of destroying the union is announced by the Detroit Seamless Steel Tubes Co., Detroit, Mich. Applications are steel-backed bearings, tubes for corrosive liquids and for water-tube boilers where a lining metal of high heat conductivity is advantageous. VVK (9)

The Light Alloys in Decoration (Le leghe leggere nell' arredamento). *Metalli Leggeri*, Vol. 1, May-June 1931, pages 25-33.

Discussion and photographs of applications in architecture, household, furniture, show cases, etc. HWG (9)

Petroleum Industry Increases Applications of Low-Cost, Corrosion-Resisting Cast Iron. *Inco*, Vol. 10, No. 4, 1931, pages 15-16.

The depreciation of pipe lines in the petroleum industry is very high, varying from 5% to 25%/yr. A special alloy "Ni-Resist" is particularly recommended for commercial purposes of this kind. It is available in all forms of castings for the requirements of the petroleum industry. Hardness and corrosion diagrams are reproduced. Its composition is as follows:

	Minimum	Maximum
Total C	2.75	3.10
Si	1.00	2.00
Ni	12.00	15.00
Cu	5.00	7.00
Cr	1.25	4.00
Mn	1.00	1.50
S	0.04	0.12
P	0.04	0.30

Ha (9)

Sheet Metal Products. *Iron & Steel of Canada*, Vol. 14, Mar. 1931, pages 47-49, 58.

An article, accompanied by 11 photographs, in which are described methods of fabricating such things as bedsteads, doors, etc. from oxwelded sheet metal. OWE (9)

All Welded Oil and Gas Field Storage Tanks. Orville Adams. *Welding*, Vol. 2, Nov. 1931, pages 737-741.

Tanks of a capacity from 5000 to 80,000 bbls. are now welded without the use of stitching rivets or fitting-up bolts; mill run steel is used without being resquared. The method of construction, erection and welding is described in detail and results of tests with lap and butt welding with single and double strap are reproduced. The saving in material and shop work is estimated to be as much as 25-30% of the total cost. Ha (9)

Hollow Copper Cables for Electrical Transmission Lines at High Voltage (Les cables creux en cuivre utilisés pour les lignes des transmission d'énergie électrique a haute tension). *Cuivre et Laiton*, Vol. 4, Sept. 30, 1931, pages 423-425.

The increase of the diameter of the cable is the most effective means for the reduction of the corona losses in high-tension transmission lines. Hollow cables, therefore, of the same section as the solid cable would have are used. Beside the reduction of corona losses, the hollow cable can carry a greater current for the same temperature increase:

Section	Cable	Amperes admissible for temperature increase of 10°C.	15°C.	20°C.	25°C.	30°C.
185 mm.^{2}	solid	263	322	372	416	456
	hollow	313	383	442	495	542
210 mm.^{2}	solid	289	354	408	456	500
	hollow	350	428	495	553	606

The construction of such cables and the methods of connection are briefly described. Ha (9)

Production of Sheet Metal Containers. S. D. Brootzkoos. *Metal Stampings*, Vol. 4, Apr. 1931, pages 301-305.

First part of a serial article. Deals with early manufacturing developments and standard specifications for tin cans of various types. MS (9)

Copper-Back Boilers in Kitchen Grates. *Engineer*, Vol. 151, Jan. 16, 1931, page 73.

Extensive tests have recently been made by the city of Birmingham gas department with the coöperation of the Copper and Brass Extended Uses Council. Tests were carried out to determine whether coke could be used as fuel without causing external corrosion of the Cu used in kitchen boilers. Results showed Cu to be very serviceable. Coke did not cause corrosion of the Cu. Specially refined Cu is more stable than either cold or hot rolled Cu. See also comments in *Engineering*, Vol. 131, Feb. 20, 1931, page 269 under the title "Coke Fires and Copper Flue-Back Boilers." LFM (9)

Golden Gate Bridge to be Longer Than Hudson River Bridge. *Iron Age*, Vol. 127, June 18, 1931, pages 1979, 2008.

Suspension structure measuring 4,200 ft. between centers of supporting piers with suspended side spans of 1,125 ft. each, making a total length of 6,450 ft.; each tower to be 746 ft. above water and made of steel. Designed for a dead load of 21,600 lb. for each linear ft. on main span, and 20,300 lb. on side spans. C and Si steels used. Wire specifications call for cold-drawn, with minimum ultimate strength of 220,000 lb./in.^{2} Yield point, 16,000 lb. and cable stress of 82,000 lb. Ductility is 4% elongation in 10 in. VSP (9)

Lead Sheaths for Cables. N. A. Allen. *Electrical Review*, Vol. 108, Feb. 13, 1931, pages 275-276; Feb. 20, 1931, pages 321-322.

The requirements which lead-covered cables must fulfill from the mechanical, chemical and physical points of view and which vary considerably for aerial, underground and submarine cables, are discussed thoroughly. The lead-improving alloys are described and their prices considered. It is demonstrated that, taking into account all relevant factors (as well as costs) the most suitable sheathing for paper insulated cables, both for general purposes and particularly for severe conditions, is lead antimony. Ha (9)

Babbitt Bearing. Robert E. Bultman (White Motor Co.). *Metal Progress*, Vol. 20, Nov. 1931, pages 55-56.

The author discusses the composition, casting conditions, grain size, and virgin raw materials used in the production of White Motor babbitt bearings. WLC (9)

HEAT TREATMENT (10)

Heat Treatment for Aircraft Engine Crankshafts. E. F. LAKE. *Heat Treatment & Forging*, Vol. 17, Aug. 1931, pages 763-767.

Instructions for annealing, hardening and tempering, with micrographs of the structural changes caused by quenching and tempering at different temperatures are given. Ha (10)

The Heat Treatment of the γ-Monohydrate of Ferric Oxide. R. D. WILLIAMS & J. THEWLIS. *Transactions Faraday Society*, Vol. 27, Dec. 1931, pages 767-771.

Contains 8 references. When prepared at room temperature from $FeCl_2$ and Ca $(OH)_2$, $Fe_2O_3.H_2O$ has the same crystal structure as γ-hydrate. On heating in the temperature range 250°-300° C., it is converted to the cubic form, and in the range 500°-600° C., to the rhombohedral form, there being no definite transition temperature. The size of the crystals at the various temperatures is given. PRK (10)

Contribution to the Economic Heat-Treatment of Steel. (Beitrag zur wirtschaftlichen Wärmebehandlung des Stahles.) ERNST BOCK. *Maschinenbau*, Vol. 10, Feb. 19, 1931, pages 127-132.

The author shows how the annealing and hardening processes used increase the quality and value of the resultant material and how the costs of heat treatment can be reduced. MAB (10)

Heat-Treating Methods and Costs. ERNEST FOSTER DAVIS. *S. A. E. Journal*, Vol. 29, Dec. 1931, pages 474-475, 478.

Development of continuous automatic methods for annealing, carburizing and hardening steel have made quality much more uniform than it could be when it depended upon the skill, attention and faithfulness of workmen. Modern furnaces carry out a scientifically planned cycle more accurately than workmen can, so that the depth of case, for instance, can be held to closer limits. The cost of the processes are greatly reduced; and far greater economies result from the increased uniformity of the product, which makes machining easier and reduces the number of defective parts. The choice between sources of heat should be made only on the basis of results. Developments in forging are prophesied that will provide far greater accuracy than in present methods and will eliminate the formation of scale. Continuous carburizing furnaces using gas as the carburizing medium are also now in the process of being developed. Estimates show that carburizing can be done satisfactorily at a cost of about 0.6 cents/lb. in this manner. WAT (10)

Heat Treatment for Large Forgings. W. J. MERTEN. *Heat Treating & Forging*, Vol. 17, Sept. 1931, pages 870-871, 875.

A general discussion of improving the quality of forgings of large mass and considerable weight by proper heat treatment. Tempering and quenching of such forgings require the utmost care in uniformly slow heating in order to avoid incipient failures by the formation of surface fissures due to warping and severe local straining during heating. In the heat treatment of large forgings, carbide dispersion or relocation is not as important as orderly grouping of alloying elements and metalloids other than iron carbides and the Fe-C thermal and constitutional equilibrium diagram is only of secondary importance. The temperature zone of maximum solid mobility of components is, however, of the greatest importance in the heat treating practice for large forgings. Ha (10)

Hardening (10a)

Electric Eye Means Accurate Heat Treatment. *Metal Progress*, Vol. 21, Jan. 1932, pages 43-45.

Describes the new process of the Thompson Products Co. for spot hardening of gas engine valves. The operation was formerly done with an oxy-acetylene torch controlled by the judgment of the operator. Electric heat is now applied under the control of a photoelectric cell sensitive to 15° F. The new heating and control has resulted in a superior product at reduced cost. WLC (10a)

Selecting and Hardening High-Speed Steel. ALFRED HELLER (Hercules Electric Steel Corp.). *American Machinist*, Vol. 74, Apr. 23, 1931, pages 635-638; Apr. 30, 1931, pages 685-688; May 7, 1931, pages 726-728.

3 W- and 2 Co-steels were tested. All were drawn at 1050° F. for 1 hr. Hardness readings are plotted on curves which show that hardness increases with the quenching temperature at a nearly uniform rate up to 2350° F. From 2350° to 2425° F., the rate of increase is lower. Co-steels harden at lower temperatures than the W. Effect of soaking at various temperatures was tried. Soaking for one min. at 2250° F. gives the same hardness as 2300° F. without soaking. The lower temperature gives as good or better physical properties and hardening is more accurately controlled when using a short time soaking period and the lower temperature. Tougher and harder W-steels are made at 2250° F. with soaking for 1-2 mins. than at higher temperatures without soaking. Co high-speed steels are affected less by soaking at the hardening temperature or by overheating. Tempering is best done at 1050°-1075° F. and held at that temperature for 30 mins. Expansion takes place from 900°-1150° F. due to γ-Fe being converted to α at these temperatures, especially above 1000° F. RHP (10a)

Theory and Practice of Steel Hardening. (Zur Theorie und Praxis der Stahlhärtung.) FRANZ WEVER. (Düsseldorf). *Archiv für das Eisenhüttenwesen*, Vol. 5, Jan. 1932, pages 367-376.

Presented at meeting of Verein deutscher Eisenhüttenleute, Nov. 28, 1931. Includes discussion, 11 references, 20 diagrams and illustrations. The transformation of austenite proceeds in three entirely different temperature stages, each stage showing a different range of stability. New heat treatment processes are the natural result of these observations since the possibility is offered of converting steels from the pearlitic stage into the far more stable austenite-region, in order to reheat or cool further by gradual annealing, improving, or hardening operations. This assumes the stopping time in any stage to be according to definite cooling rates; for this purpose a series of ordinary hardening reagents was examined with respect to their cooling properties on steels in both the pearlite and martensite regions, showing excellent results. Groups of various hardening reagents are easily formed. GN + DTR (10a)

Annealing (10b)

Varies Annealing Temperature by Induction Regulator. R. W. MILLER. *Steel*, Vol. 88, Jan. 29, 1931, pages 38-40.

Discusses the general design, constructional features and accessory parts of several types of electric annealing furnaces made in Baden, Switzerland. Temperature control is obtained by the use of an "induction regulator" which raises or lowers the input voltage of the furnace from zero to double that of the line voltage. JN (10b)

Anneals High-Speed Steel in Pit-Type Furnace. W. S. SCOTT. *Steel*, Vol. 89, Sept. 17, 1931, pages 35-36.

Description of furnace and temperature control. In this electrically heated furnace a heat is being obtained in 24 hours; 7 hours heating, 17 hours cooling; a gas furnace required 60 hours. Ha (10b)

Continuous Strip Annealing Process and Fundamentals of Heat Transfer in Continuous Strip Furnaces. O. JUNKER. *Metals & Alloys*, Vol. 2, Dec. 1931, pages 352-354.

Translated by W. Adam (Ajax Electric Co.) from *Zeitschrift für Metallkunde*, Vol. 23, Apr. 1931, pages 124-125. Electrically heated continuous strip annealing furnaces are described for treatment of brass strip. WLC (10b)

The Annealing of Metal Strip in the Continuously-Operated Electric Furnace. *Metal Industry*, London, Vol. 38, June 26, 1931, pages 641-643.

Brass strip is annealed in horizontal and oblique electric furnaces. Automatic pickling, washing and drying units may be used with the latter type furnaces. Current consumption is around 100-130 KWH/ton. PRK (10b)

On the Annealing Brittleness. SOJI MAITA. *Tetsu to Hagane*, Vol. 17, No. 9, 1931, pages 1042-1046.

"Annealing brittleness" is a term given by the author for the phenomenon that steel slowly cooled through the entire temperature ranges in the process of annealing is brittle, compared with that rapidly cooled from a temperature slightly below the Ar_1 point, with an amplified meaning of the "temper brittleness." Several specimens of carbon steels, a Ni-steel, a Ni-Cr steel and a Ni-Cr-Mo steel were previously heated at 900° C. for 1 hr. and quenched into oil. These specimens were annealed at a temperature slightly above the Ac_3 point (marked by H), or above the Ac_1 point (marked by L), and cooled slowly in furnace to room temperature (marked by F) or quenched into water during cooling at a temperature slightly below the Ar_1 point (marked by Q), for which the Izod impact tests were carried out, and their microstructures were observed. In all cases, specimens F had a smaller impact value than specimens Q and their susceptibility to brittleness, ie., the value of $\frac{Q-F}{Q}$ was largest in the Ni-Cr steel. Furthermore, specimens H were more brittle than specimens L and, hence, the toughness was largest in specimens LQ (i.e., annealed at low temperature and quenched during cooling), followed by specimens LF, HQ and HF in order; here, it is noticeable that a specimen which is annealed at a low temperature above the Ac_1 point and slowly cooled has a larger impact value than that annealed at a high temperature and cooled from a temperature below the Ar_1 point. In microstructure, a small amount of carbide, separated in the grain boundaries of ferrite by the solubility change below the Ar_1 point, is observable in specimens F, but none in specimens Q. Also, crystal grains are coarse in specimens H, while they are fine in specimens L. From these results, it is concluded that the annealing brittleness is due to the 2 causes, i.e., coarsening of crystal grains and precipitation of carbide, the former being more effective. In order to eliminate the annealing brittleness, specimen should be annealed at a low temperature above the Ac_1 point and then be cooled rapidly below the Ar_1 point. ST (10b)

Use of Hydrocarbon Gases for Bright Annealing of Metals. E. G. DE CORIOLIS & R. J. COWAN. *American Gas Association Monthly*, Vol. 13, Oct. 1931, pages 457-459.

Some metals may be maintained bright very easily during heat treatment; the absence of free oxygen is all that is required. In zinc-bearing metals, difficulty arises from the volatility of zinc at annealing temperatures and which seems to be coincident with the liberation of occluded gases that are oxidizing and form a scale of mixed oxides that tarnish the alloy. This fact prevents the use of ordinary neutral or reducing atmospheres for this work. It was found that such metals could be made bright in an atmosphere of hydrocarbon gases under certain conditions. In such an atmosphere the minimum bright annealing temperature was 1250° F. This was too high for most annealing work. It was found that if the metal were drawn through this atmosphere at such a rate as never to attain this temperature the bright annealing reaction would continue only if the gas were held at the minimum of 1250° F. At this temperature, the hydrocarbon has cracked with the liberation of free C and H. Further study indicated that it was the H which was the active bright annealing gas. This was proved by the use of pure H and of ammonia under the same conditions, for the reactions took place in exactly the same way. Above 1250° F. in the presence of a suitable catalyst, the hydrogen becomes activated and has a power for reducing oxides not evident below that temperature. Using these ideas, a process has been developed for bright annealing wire or strip in strand form. It is applicable to ferrous and non-ferrous metals. RJC (10b)

Furnace Atmosphere Governs Bright Annealing Action. R. J. COWAN. *Steel*, Vol. 89, Aug. 13, 1931, pages 34-38.

The various atmospheres, such as H, N, CO_2, hydrocarbons, are discussed with respect to their influence of keeping metal surfaces bright during annealing. The tests have developed 2 methods, one, based on the breakdown of a hydrocarbon gas seems particularly well adapted for the annealing of metals in form of strips or wire. The other method uses flue gas and methanol and is well suited for annealing of stampings or other bulky materials which may require a lower temperature anneal. Ha (10b)

Case Hardening & Nitrogen Hardening (10c)

Deep Carburizing with Liquid Carburizers. (La cementazione profonda con cementi liquidi.) I. Musatti & L. Dainelli. *La Metallurgia Italiana,* Vol. 23, Nov. 1931, pages 1015-1028; *Giesserei mit Giesserei-Zeitung,* Vol. 18, Dec. 4, 1931, pages 922-923.

Baths such as 56% NaCN, 22% NaCl, 22% Na_2CO_3; 70% $BaCl_2$, 20% NaCl, 10 $CaCN_2$; and a "mixed bath" containing NaCN and KCN in the ratio of 4:1 and $CaCN_2$, diluted with suitable quantities of other salts, were used in carburizing steels of about 0.15% C, 3 to 4% Ni and 0.7 to 1.5% Cr. The straight cyanide bath could not be used above 880° C, while the cyanamid bath was used at 880°-930° C., but gave only slight increase in rate of carburizing at the higher temperature. The mixed bath could be used at 930° C. without the fuming or swelling encountered with the others, and its rate of carburization was much increased at the higher temperature. The straight cyanamid bath gave the poorest results of all as to depth of case. The scleroscope hardness at the surface was much lower (75-85) than that obtained with solid carburizers (90), but the layers at 0.2 to 0.3 mm. below the surface were harder (92-94) with the baths containing cyanide. The cyanamid bath produced greatest hardness at the surface but the hardness gradient fell rapidly. The mixed bath at 930° C. gave, in 2 hours, a scleroscope reading of 83 at the surface, 93 at 0.3 mm., then falling to 65 at 1 mm. In 3 hours, it gave 75 at the surface, rising to 96 at 0.6 mm. and falling only to 85 at 1 mm. The 2 hour case had 0.91% C, 0.19% N in the first 0.1 mm. layer, the same carbon in the second but the N fell to 0.05%; at greater depths, the C and N curves were practically straight lines, falling to 0.30% C and 0.10% N at 1 mm. The presence of KCN as well as NaCN and that of $CaCN_2$ are credited with causing the depth of case with the mixed bath. The exact composition of the mixed bath is not given. Repeated impact notched bar tests on the core material and on specimens carburized to 0.5 and 1 mm. with the mixed bath and with an ordinary solid carburizer plotted between energy of blow and number of blows to break, show all 3 curves crossing. At the highest stresses, the order of life is core material, solid carburized, mixed liquid bath carburized. At the lowest, the order is reversed. Contains 34 references, 17 figures, 8 tables. Ha + HWG (10c)

Nitriding of Iron and Iron Alloys. II. (Ueber die Nitrierung von Eisen und Eisenlegierungen. II.). O. Meyer & R. Hobrock. *Archiv für Eisenhüttenwesen,* Vol. 5, 1931, pages 251-260.

Report of the Institute of Ferrous Metallurgy at the Technische Hochschule Aachen. 30 references. The paper continues the previous investigation by W. Eilender and O. Meyer, *Archiv für Eisenhüttenwesen,* Vol. 4, Jan. 1931, pages 343-352, reviewed in *Metals & Alloys,* Vol. 2, Sept. 1931, page 177. Electrolytic iron was nitrided at 550° C. for 2, 5, 8, 11, 15½, 21½, 30, 40 and 87 hrs. The dissociation of ammonia was kept below 10%. The hardness was determined at various depths of the case with a Firth hardness tester, but the readings were converted to Brinell. In plotting the hardness against the depth of case, a maximum of hardness was observed on every curve for the various nitriding temperatures. No strict relation between this "spitzenhärte" and time of nitriding seems to exist. (This occurrence of a maximum on the hardness-depth curve has been observed by the authors for the first time, but it may be pointed out that an indication of such an occurrence was observed and described in the simultaneously published paper by O. E. Harder and G. B. Todd, *Transactions American Society for Steel Treating,* Vol. 19, Nov. 1931, pages 41-65. In 2 of the samples there also was the hardness at a depth of about 0.003 to 0.004 in. somewhat higher than at the surface). In nitriding at higher than the above mentioned temperatures the maximum of hardness is found at greater depths but, when the nitrided specimens are annealed for some time at 550° C. or higher temperatures, the location of maximum hardness in the specimen is shifted in the other direction. The nitrogen contents at maximum hardness are very far below those which have been given as the solubility limit of nitrogen in α-iron at room temperature. To study the causes of nitrogen hardness, X-ray pictures were taken of successive layers of nitrided specimens 0.1 mm. thick, but the results are not yet sufficient to find a reasonable explanation. Similar experiments were carried on on Fe-Al alloys containing 0.09%, 0.17%, 0.40%, 0.70%, 0.80%, 1.08%, 2.08% and 3.66% Al and nitrided for 48 hrs. at 550° C. The surface hardness after a steep increase with increasing content of Al attains a maximum at 0.8% Al, to decrease again at higher contents without showing a continuous curve but having another maximum and 2 minima. The hardness-depths curves were also plotted. Maximum hardness occurs below the surface at concentrations above 0.70% Al. X-ray patterns were taken of layers of a 0.8% Al alloy nitrided for 24 hrs. at 550° C. The hardness of nitrided Fe-Al alloys is due not to a single effect but to the following reactions. (1) The largest increase of hardness is caused by the hard and insoluble compound AlN in blocking the gliding planes. (2) A smaller extent of hardness is due to the deformation of the iron lattice by AlN. (3) Nitrogen reacting with the iron matrix increases the hardness in the fields of low concentrations of nitrogen, i.e., in greater depths of the specimen. (4) At higher contents of Al, the formation of layers of precipitation can cause an increase of hardness. GN (10c)

Nitrided Valve Guide Bushings for Airplane Motors (Nitrierte Ventilführungsbüchsen für Flugzeugmotore). J. Wizemann. *Deutsche Motorzeitschrift,* Vol. 8, May 1931, page 198.

Points out the technical difficulties inherent in the valves of airplane motors and discusses the advantages of nitrided valve guide bushings. EF (10c)

Carburizing in Electric Furnaces. (La cémentation au four électrique). *Journal du Four Electrique,* Vol. 40, Dec. 1931, pages 477-480.

A translation of an article in *Machinery* dealing with the advantages of electric furnaces for carburizing purposes and giving production figures from the installation of David Brown and Sons, Ltd. JDG (10c)

Case-Hardening with Liquid Carburizing Agent. *Engineering,* Vol. 131, June 19, 1931, page 803.

Describes new case-hardening process in which a liquid is used, Carbonal, which has a vegetable base and is rich in hydro-carbons. Illustration shows the apparatus and electric furnace used in the process. LFM (10c)

Moisture in Gas has Effect on Carburizing Action. *Steel,* Vol. 88, Mar. 5, 1931, pages 59-63.

Gas used for carburizing should first be dried thoroughly as the moisture contained in it often prevents satisfactory carburization. The steel to be carburized should be first exposed to CO_2 gas for a brief period as this gas serves to remove from the steel a dead surface film which retards the penetration of carbon. Suitable burners for gas carburization are described briefly. Ha (10c)

The Development of Continuous Nitriding. R. J. Cowan. *Heat Treating & Forging,* Vol. 16, Oct. 1930, pages 1277-1280.

A general discussion of nitriding and detailed information regarding the process as carried out in continuous furnaces. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 132. Ha (10c)

Nondeforming Alpha-Delta Carburizing Steel. A. B. Kinzel (Union Carbide and Carbon Research Lab.). *American Society for Steel Treating, Preprint* No. 15, 1931, 10 pages.

Paper read and discussed before the Boston Convention of the Society, Sept. 1931. The author attributes the distortion experienced in the heat treatment of carburized work to the changes in volume involved in the phase changes of the core material. In line with this idea, an alloy steel for carburizing has been developed which has no α-γ transformation. The well known loop of the γ-Fe range in Cr steels is made use of with similar conditions in the diagrams for Si and V. By proper combination of these alloys, a steel of low alloy content can be produced at reasonable cost which will have no transformation in the core. At carburizing temperatures, α-Fe will slowly absorb C; the higher C thus attained shifts the loop so that the γ-transformation takes place and C is rapidly absorbed by the austenite. Tests have demonstrated that this combination results in a very minimum of distortion on quenching and the core properties are improved by the alloy additions. The compositions and physical properties resulting from this type of steels are given. WLC (10c)

Malleableizing (10g)

Black Spots in Malleable (Quelques remarques sur un défaut de fonderie: "le noir de la malléable). M. Kagan & R. Deprez. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 875-877.

Black patches in white iron for malleabilizing are considered to be due to gas penetrating into heat-cracks. The cracks form through improper design of the casting, wrong gating, or lack of precautions in molding. HWG (10g)

Malleable Iron with Black Core in the Cupola Furnace (A propos de fonte malléable a coeur noir au cubilot). Ch. Kluijtmans. *Revue Fonderie Moderne,* Vol. 25, Sept. 10, 1931, pages 327-328.

The author maintains that a good malleable iron can be produced in the crucible as well as in the reverberatory furnace, provided that all cementite is decomposed in fixed cementite before the thermal treatment has gone too far. Ha (10g)

Pots for Malleableizing. (Tempertöpfe.) W. Bernhard. *Zeitschrift für die gesamte Giesserei Praxis,* Vol. 53, Jan. 24, 1932, pages 44-45.

Brief description on production and composition of pots for malleableizing. GN (10g)

Effect of Molybdenum on Graphitization of White Cast Iron. W. H. Jennings, Jr. & E. L. Henderson (Iowa State College). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 223-225.

5 references. The authors report a study of the effect of Mo up to 5% in malleable iron. Its presence results in a grain refinement and rates of graphitization are inversely proportional to the amount of Mo present. Mo increases the hardness, toughness and tensile strength of malleable iron. WLC (10g)

Malleable Iron—Recent Progress. H. A. Schwartz (National Malleable & Steel Castings Co.). *Metals & Alloys,* Vol. 2, Sept. 1931, pages 143-149. 36 references.

The author discusses the compromise between high and low C, high and low Si with consideration of the size of section in making malleable iron. The alloy must freeze without precipitation of graphite but must graphitize in a reasonable time by treatment. The annealing cycles necessary to achieve complete and satisfactory graphitization are discussed. It is stated that malleable iron is the most readily machinable ferrous alloy known. The differences between European and American malleable are pointed out, white heart and black heart, respectively, are the most prevalent types of malleable made in the 2 continents. The effect of other elements on malleable are discussed as to their effect upon graphitization. Al, Zr, U, Ti, Ni, Si, B in small amounts only, Cu and Co only slightly, accelerate graphitization. Cr, Mn, V, S, Se, Te, B over 0.10%, Mo in fair amounts, Sb and Sn are retarders of graphitization. The various views on the mechanism of graphitization are discussed. Applications of malleable castings are discussed. The author gives 8 cautions to engineers using malleable. WLC (10g)

The Annealing of Malleable Iron (Das Glühen von Temperguss). V. Wollenigh. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 6, 1931, page 868.

In order to shorten the duration of annealing, the temperature is increased to 1000° C., the content of C is reduced considerably and that of Si is increased. The content of P must not exceed 0.2%; S must be kept as low as possible. The content of Mn is calculated from % Mn = % S × 1.7 + 0.2. Under these conditions, the annealing takes, in all, about 35 to 40 hrs. Samples showed a tensile strength of 35-40 kg./mm.² and 7-10% elongation. This annealing process can also be applied for black-core malleable castings. Ha (10g)

JOINING OF METALS & ALLOYS (11)

New Developments in Pipe Joints (Neuzeitliche Rohrleitungsverbindungen). E. H. A. Thau. *Gas- und Wasserfach,* Vol. 74, Oct. 17, 1931, pages 861-866.

Abridged in *Gas World,* Vol. 95, Dec. 5, 1931, *Coking Section,* pages 12-14. The recent developments in the gas, water and oil industries have led to the increase in the complexity of the network of transmission lines. The connecting of individual pipes or systems with others requires precaution and care. The chief causes for leakages occurring in those connections were investigated and it was concluded that the joints should be required to be of specified quality. The article discusses flanges, screws, screw-caps and weld seams, the improvement of welds in steel tubes and in cast tubing, taking into consideration pressure, variation in temperature, gravity, etc. Several commercial types of joints and materials are described. MAB (11)

Welding or Riveting in Chemical Equipment Manufacture? (Schweissen oder Nieten im Chemischen Apparatebau?) H. Buchholz. *Chemische Fabrik,* Vol. 4, Oct. 21, 1931, pages 413-414; Oct. 28, 1931, pages 421-422.

Contains 4 references. It is shown that, in welded chemical equipment, corrosion takes place along the riveted seam and in the rivets due to strains in the metal. The corrosive attack assumes the same pattern as the strains in the metal. This can be reduced by thoroughly annealing the metal. Acids and other solutions which tend to dissolve the metals attack them in the form of grooves, while NaOH, $Ca(NO_3)_2$, $NaNO_3$ and NH_4NO_3 produce intercrystalline corrosion. Photographs of rivets attacked by chemicals are shown. For these reasons, riveted construction is not recommended for chemical equipment. Good quality welding is stronger, more corrosion-resistant and cheaper. Oxy-acetylene welding, together with hammering to form small grain size and exclude gases and slag, produces good results. It is better to anneal the parts after welding. For cast iron, oxy-hydrogen welding is better. Electric welding has not been used much for chemical equipment as it is difficult to obtain perfect joints free from inclusions. CEM (11)

The Soldering of Brass and Copper Tubes in Sanitary Plumbing. (La Soudure des Tubes en Laiton et en Cuivre dans les Installations Sanitaires.) *Cuivre et Laiton,* Vol. 4, Dec. 15, 1931, page 551.

Description of methods of joining tubes by soldering and brazing. Ha (11)

Soldering and Welding Aluminum and Its Alloys. (Das Löten und Schweissen von Aluminium und seinen Legierungen). Ernst Weber. *Giesserei-Zeitung,* Vol. 27, Feb. 1, 1930, pages 72-76.

Al and its alloys are difficult to solder because (1) the thin skin of thermally resistant and chemically inert oxide hinders a firm alloying of the metal and solder, (2) the high specific heat and thermal conductivity of Al cause in spots a "quenching" of the liquid solder, and (3) the strong electropositive nature of the metal sets up reactions in the presence of liquids or moist air. Most modern Al solders consist principally of Sn with some Al and Zn. Many contain also Sb, Bi, Cd, Cu, Pb, Ni, Ag and other metals. Soldered joints are tested in steam, boiling salt solution, or in boiling H_2O for several days. The tensile strength is 5 kg./mm.^{2}, which is lower than that of Al. In order to meet chemical and mechanical specifications, autogenous welding is recommended. Al is one of the most weldable of metals, if the following characteristics are kept in mind: (1) low resistance against oxidation, (2) high coefficient of expansion, (3) high thermal conductivity, (4) low melting point, (5) low tensile strength at high temperatures, (6) tendency to warp. Modern fluxes consist of alkaline chlorides, fluorides, bisulphates, etc. A slightly reducing oxy-acetylene flame gives good results. Welded joints should be guarded against too rapid cooling. (11)

Brazing (11a)

Brazing by Resistance Method. W. C. Reed, M. Unger & G. E. Gifford. *General Electric Review,* Vol. 33, Oct. 1930, pages 568-570; *Brass World,* Vol. 26, Oct. 1930, pages 267-269.

Many metals, such as Cu, Ag, Ni, steel and their alloys, can be brazed electrically. See *Metals & Alloys,* Vol. 2, Mar. 1931, page 70. (11a)

Copper Brazing in Controlled Atmosphere Furnaces. H. M. Webber (General Electric Co.). *Metals & Alloys,* Vol. 2, Nov. 1931, pages 284-287.

The technique of copper brazing in an atmosphere of hydrogen is described. Applications of the method to the joining of metal golf shafts, carboloy tips to various holders, refrigerating machine parts and other parts are described. Hydrogen reduces any oxides formed and the very fluid copper flows readily into all joints making a sound connection. WLC (11a)

Brazing Carbon Steel. Burton W. Wheeler. *Power,* Vol. 74, Oct. 6, 1931, page 503.

To braze C steel for tempering, Cu only is used instead of Cu-Zn spelter. The parts must be heated to higher temperatures than for an ordinary job. After brazing, the C steel should be annealed, hardened and drawn. AHE (11a)

Brazing with a Self-Fluxing Alloy. C. J. Snyder. *Machinery,* Vol. 37, June 1931, pages 760-762.

Parts are brazed together in an electric brazing machine by the use of a self-fluxing phosphor-copper alloy which thoroughly fluxes the joint. Methods of making different types of joints are explained. Ha (11a)

Lowering of the Over-head Expenses in Gas Plants and Water Plants by the Utilization of the Welding Technique. I. Hard Soldering (Senkung der Betriebskosten in Gas- und Wasserwerksbetrieben mit Hilfe der Schweisstechnik. I. Hartlöten). F. Wechwerth. *Gas und Wasserfach,* Vol. 74, July 18, 1931, pages 678-684.

The economical utilization of the oxy-acetylene torch in connection with a bronze solder (59-63% Cu, 36-40% Zn, 0.5-1.5% Sn) for repair work in gas plants and water plants is given at length and a great number of practical examples are presented in 24 illustrations. The reduction of the soldering temperature of the torch is stressed in the discussion of the procedure of hard soldering. EF (11a)

Silver Brazing of Monel Metal and Nickel. R. J. McKay. *Western Machinery World,* Vol. 22, June 1931, pages 256-257.
Though bearing the name of "solders" silver solders are strictly speaking brazing or welding metals. They lie in between soft solders and welding metals. A silver solder, developed in conjunction with the International Nickel Company and recommended by Handy & Harman, known as type RT, flows at the temperature of 1325° F. and is recommended for joining Monel metal and Ni. Boric acid and borax may be used as a flux. WHB (11a)

Soldering (11b)

Soft Solders and their Application. G. O. Hiers (National Lead Co.) *Metals & Alloys,* Vol. 2, Nov. 1931, pages 257-261, 277.
47 references. An equilibrium diagram for Pb-Sn system is given and discussed. The addition of small amounts of Sb results in a "peritectoeutectic point" at Pb 40%, Sn 57½% and Sb 2½% with a reaction temperature of 188° C. A.S.T.M. specification for soft solder cover 11 compositions varying from 31-63% Sn, up to 2% Sb and balance Pb except for permissible impurities. British Standards list 8 solders of similar composition and one of 95% Sn and 5% Pb, permissible Sb up 0.3%. The nature of a soldered joint is discussed; alloying is desirable but not essential. A deposit of Pb acting as a solder is obtainable on Al by heating lead chloride in contact with Al; no alloy results. A solder must be adhesive. The rule for soldering is cleanliness of the metal. Mechanical and etching methods for cleaning are discussed. Fluxes are discussed: those which act to prevent oxidation and those which act as a scavenger, also $ZnCl_2$-NH_4Cl flux acts in the latter way. Method of application of solder varies with the size, shape and nature of the parts being soldered; the speed of soldering and the mechanical properties obtained in the joint depend upon the method employed. Methods are discussed under wiping, soldering tool or "iron," blow torch, sweating, and dipping. Modifications or combinations are worked to advantage for certain jobs. The surfaces to be soldered must be brought to the solder temperature. Special applications of these methods are described. Curves show the mechanical properties to be obtained from soldered joints; one shows effect of temperatures and "creep." WLC (11b)

Brazing or Hard Soldering Metals with Silver Solders. A. Eyles. *Sheet Metal Industries,* Vol. 5, July 1931, pages 182-186.
The application of silver solders is possible on brass, bronze, copper, Monel metal, nickel, iron, steel and stainless steel. The melting points of silver solders vary from 1250°-1600° F. The most reliable flux is fused borax. Coarse grained structure and distortion result from overheating. AWM (11b)

Silver Solders and Their Use. R. H. Leach (Handy & Harman.) *Metals & Alloys,* Vol. 2, Nov. 1931, pages 278-283.
The author reports a metallographic study of Ag solder joints with Cu, brass, Ni-Ag, Monel, and Fe. 4 solders of following compositions were studied:

Silver	20%	50%	65%	80%
Copper	45%	34%	20%	16%
Zinc	20%	16%	15%	4%
Cadmium	5%	....	....	....

The diffusion of the solder into the base metal was studied by holding soldered joints molten for periods up to 2 hours. Holes drilled in blocks of metal were filled with solder, covered with borax flux and held at several hundred degrees above the liquidus of the solders for various periods and examined under the microscope. The zone of diffusion was definite though shallow in cases where no superheat was applied. Superheat produces greater diffusion. Practical applications of Ag soldering are discussed. The use of fluxes and technique for elimination of "balling up" and pinholes are discussed. With proper handling high Zn solders will not cause pinholes. WLC (11b)

Special Solders. *Metallurgist,* Oct. 1930, pages 157-158.
A critical abstract of "A New Solder for Electrical Apparatus" by James Silberstein in the Aug. 1930, *Metals & Alloys,* For abstract see *Metals & Alloys,* Vol. 2, Mar. 1931, page 70. VVK (11b)

Welding & Cutting (11c)

The Welding of Magnesium Alloys. *Engineering,* Vol. 131, May 22, 1931, page 681.
Messr. Barimar, Ltd., London, report the successful welding of Elektron. This is an Al-Mg alloy containing about 10% Al and small amounts of Zn, Cu, Mn, and Si. LFM (11c)

Experiences with an Electrically-Welded Ship. *Engineering,* Vol. 131, Apr. 3, 1931, pages 460-461.
Comments on satisfactory condition of an all-welded vessel even after 2 serious accidents. If the ship had been of riveted construction, much more damage would have resulted, both to the steel plates and to the cargo. After 11 yrs. of service, there is no excessive corrosion in any part of the welded structure. Illustrated. LFM (11c)

Welding of Rails. (Das "Aufarbeiten" von Schienen.) Th. Wuppermann. *Organ Fortschritte des Eisenbahnwesens,* Vol. 86, Aug. 1, 1931, pages 327-329.
The advantages of cutting and joining rails in the field by thermit-welding are pointed out, as this method does not require a welding outfit. Ha (11c)

Recent Investigations in the Fields of Welding and Cutting Technique. (Neuere Untersuchungen auf dem Gebiete der Schweiss- und Schneidtechnik.) W. Zimm. *Die Wärme,* Vol. 54, Nov. 28, 1931, pages 881-884.
Investigations of the past years yielded new conceptions regarding the advantageous utilization of the welding torch. The significance of critical heat stresses during the welding operation appears to be strongly over-emphasized. The influence of the welding flame and the properties of the welding rod are considered. EF (11c)

Welded Sheet Aluminum Work. *Sheet Metal Worker,* Vol. 22, Dec. 11, 1931, pages 689-691.
Illustrations of welded gutters and leaders and general hints how to do the work economically. Ha (11c)

Practical Hints for the Welder. (Praktische Winke für den Schweisser.) *Die Schmelzschweissung,* Vol. 10, Dec. 1931, pages 278-279.
Causes of failures are often due to faulty holding of the flame, the welder gets too close to the piece. The particular conditions of welding of cast-iron, brass and Al are discussed. The piece should be preheated with a small flame, the apparatus should always be kept clean and in good condition. Ha (11c)

Steel Foundry Welding. *Edgar Allen News,* Vol. 10, Oct. 1931, pages 972-976.
Discussion of a paper by V. Gordon Pierson in which the many useful applications of welding to steel castings were commented on and the difficulties in relation to blow holes, porosities, breaks and the best way of mending them are discussed. Ha (11c)

Non-destructive Tests in Welding. (Zerstörungsfreie Prüfung von Schweissungen.) K. L. Zeyen. *Die Wärme,* Vol. 54, Apr. 25, 1931, pages 229-231.
This review of the non-destructive tests in welding technique pertains to: visual examination, kerosene test, magnetic test according to Roux, electrical test of Sperry and modifications of Hodge, stethoscopic test (Dawson, Kinzel), examination by X-rays (Kantner, Herr, Lefering) and fatigue water pressure tests according to Hodge. EF (11c)

Estimating Field-Welding on Multi-Story Buildings. *Engineering News-Record,* Vol. 108, Jan. 21, 1932, pages 94-95.
A study of the costs, time used, materials, and other economic details on 3 buildings, each 14 stories or over, in representative sections of the United States. Valuable tabulations and discussion are included. CBJ (11c)

Arc-Welding Progress that Tends to Eliminate the Human Factor. *Metallurgia,* Vol. 5, Dec. 1931, pages 35-36.
The shielded arc has made possible the production of welds that are just as reliable as riveted joints. Curves showing the correct ratios for Mn, Si and Al in welding rods are shown. JLG (11c)

Welding Qualities of Steel. Wilmer E. Stine. *Iron & Coal Trades Review,* Vol. 123, Dec. 11, 1931, pages 906-907; *Foundry Trade Journal,* Vol. 45, Dec. 24, 1931, pages 387-398.
A study was made of the various elements which affect the results in arc-welding including the steel used in the manufacture of shapes and plates as well as the electrode material. Curves are reproduced indicating Al, Si and Mn content of optimum arc-welding characteristics. In general it could be stated that aluminum oxides or any other non-metallic inclusion in steel which has its melting point between the melting point and boiling point of steel will cause slag holes or pits in the weld metal of electric-arc-welded steel unless it is fluxed with a material which lowers the freezing point below that of the steel. Al, Ag, Mn or any other deoxidizers having gas-solvent properties which are present in excess of the quantity necessary for chemical equilibrium with the oxygen present in the steel at a temperature slightly above the temperature of solidification may cause the formation of gas holes in the weld metal of arc-welded steel. OWE + Ha (11c)

Testing Steel Sheet for Weldability. *Metal Stampings,* Vol. 4, May 1931, page 414.
Describes a ready blowpipe test for determining the welding quality of steel sheet. JN (11c)

Report of Structural Steel Welding Committee. *Journal American Welding Society,* Vol. 10, Nov. 1931, pages 18-40.
Second installment of report of Structural Steel Welding Committee of the American Bureau of Welding. Consists of Sections 3, 4, and 5 which deal with welder qualification test results, adjustment of length and cross section of welds, and program test results. Many photographs of typical failures are shown together with graphs showing test data. TEJ (11c)

Reduction of the Operating Cost of Gas and Electric Works by Welding Processes. I. Hard Soldering (Brazing). (Senkung der Betriebskosten in Gas- und Wasserwerksbetrieben mit Hilfe der Schweisstechnik.) *Das Gas- und Wasserfach,* Vol. 74, July 18, 1931, pages 678-684.
Discusses the welding of various parts such as casings in motor frames, casing for diaphragm rims in centrifugal pumps, distance pieces for tubing, water meter flanges, hubs and headers of cog wheels, valve flanges, water jackets in compressors, bell crank levers, valve discs in diaphragm pumps, etc. Welding is done with bronze rods of a composition of 59-63% Cu, 36-40% Zn and 0.5-1.5% Sn. Investigations of failures, including tensile tests and microscopic examinations due to cracks and fissures are carried out. MAB (11c)

New Electric Welded Pipe Process Differs from American Practice. *Steel,* Vol. 88, Jan. 29, 1931, page 40.
A new process for the manufacture of welded pipe and tubing has been developed in Norway and is now in use in 5 European plants. This process permits the electric welding of hot rolled open seam tubing without pickling, cleaning or shearing at production speeds up to 80 ft./min. JN (11c)

Standard Tests for Welds. Revision of Bulletin No. 1, American Bureau of Welding. *Journal American Welding Society,* Vol. 10, Nov. 1931, pages 14-17.
Standard procedure for preparation of samples and test specimens, tensile test of base metal, tensile test of weld metal, tensile test of welds, bend tests of welds and shear tests of fillet welds. TEJ (11c)

Pullman Builds All-Welded Hopper Cars for C. G. W. *Journal American Welding Society,* Vol. 10, Nov. 1931, pages 5-7.
Reprinted from *Railway Age.* 5 70-ton hopper cars for coal transportation will each produce $400 more revenue/yr. than riveted cars, due to substantial saving of weight because of their all-welded construction. TEJ (11c)

Announces Production of 6 to 24 Inch Diameter Spiral Welded Pipe. *Steel,* Vol. 88, Feb. 19, 1931, page 47.
This is produced in 40 ft. lengths by the American Rolling Mill Co., Middletown, O., from coiled strip. 200 ft. in length The spiral seam is formed by feeding the flattened strip into the welding machine at an angle of 45°. This results in a straight, true-round, rigid pipe with smooth inside walls. The finished pipe is tested hydraulically. JN (11c)

WORKING OF METALS & ALLOYS (12)

Securing Quality in Steel Plate. J. Stewart Huston (Lukens Steel Co.). *Metals & Alloys*, Vol. 2, Oct. 1931, pages 209-213.

The author recounts experience in manufacture of plate steel. He discusses the quality of plate under the various operations melting, pouring, molds, heating, rolling, cutting and inspection. The applications of "open" and of "killed" steels are discussed as are the defects resulting in plate from faulty melting and casting. The effect of alloy content and the fabrication of structures from welded plate is discussed. WLC (12)

Melting & Refining (12a)

The Distribution of Non-Metallic Inclusions in Steel Ingots, and the Effect of Deoxidizers Upon the Distribution with Special Reference to Zirconium, Sodium and Calcium. (Die nichtmetallischen Einschlüsse in Stahl, ihre Verteilung im Gussblock und ihre Beeinflussung durch Desoxydationsmittel, insbesondere durch Zirkon, Natrium und Calcium). W. Zieler. *Archiv für Eisenhüttenwesen*, Vol. 5, Dec. 1931, pages 299-314.

The distribution of non-metallic inclusions in steel was determined in 50 heats of SAE 4140 of normal production and in other heats made in the electric furnace which had been deoxidized with zirconium, sodium and calcium. The amount and distribution was studied in all steels by counting the number of inclusions in an area of ½ in.^{2} of 5 × 5 in. billets, representing top, bottom and middle of the ingots. The results show that the non-metallic inclusions in the ingot are distributed as follows: Inclusions of oxides and silicates are most numerous in the bottom of the ingot and also show the largest dimensions there. Inclusions of sulphides coincide with the segregations and, therefore, are more numerous in the top of the ingot. The occurrences during solidification and their effect upon the distribution of the inclusions are considered. The formation, within, and the elimination of non-metallic inclusions from the liquid steel bath are essentially affected by the ratio of manganese to silicon during the melting down and the working period of the heat as well as the state of the melt at the time of the first additions of the alloying elements. A high content of manganese at the end of the melting-down period decreases the number of inclusions. A high content of silicon at the end of the melting-down period increases the amount of the silicate inclusions. If an alloy containing larger amounts of silicon and carbon is added to an incompletely deoxidized steel bath, silicon oxidizes to silica and part of the carbon, to carbon monoxide which, again, causes the formation of silica during a later addition of silicon. The formation of silicates is practically negligible in completely deoxidized heats. Deoxidation with silicon and manganese together is always preferable to a deoxidation with manganese only, since silicon and manganese form an iron-manganese silicate with a low melting point which can be better removed. It is advisable to add manganese before the addition of silicon so that in adding ferro silicon a sufficient amount of manganese oxide is already present to form the iron manganese silicates. The influence of zirconium, titanium, cerium, sodium and calcium as deoxidizers was studied. Titanium prevents segregations without interfering with the cleanliness of the steel. TiO_2 lowers the melting point of the silicate slag and thus facilitates its elimination. Ti also forms the compound TiN thus eliminating nitrogen. Zirconium combines with S to ZrS_2 and with N to ZrN and decreases the number of non-metallic inclusions. The best results as to cleanliness of the steel are obtained when Zr is added to the ladle, although the number of nitride inclusions increases in this case. However the inclusions of ZrN are of a very small size and no impairing influence upon steel quality could be observed. Cerium increases the non-metallic inclusions in steel. Sodium is unsuitable as deoxidizer since it reacts explosively and makes it impossible to get a proper ingot. Calcium seems to be fit as deoxidizer. It decreases the oxygen content and the non-metallic inclusions in steel. 17 references. GN (12a)

A Thermal Study of an Open-Hearth Furnace. Wm. M. Henry & T. J. McLaughlin. *Engineering*, Vol. 131, June 1931, page 802; *Fuels & Furnaces*, Vol. 9, June 1931, pages 703-706, 716.

Paper read before the American Iron & Steel Institute, New York, May 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 281. LFM + Ha (12a)

The Volatilization of Antimony in the Converter. (Ueber die Verflüchtigung des Antimons im Konverter.) W. Kroll. *Metall und Erz*, Vol. 28, Nov. 1931, pages 521-523.

Contains 2 references. Attempts to recover Cu from Cu-Sb slags by volatilizing the Sb in converters have failed because only a small amount of the Sb can be driven off. It is necessary to form Sb_2O_3 which is volatile, and which forms at 1150° to 2200° C. At lower temperatures Sb_2O_4 forms, which is not volatile. Conditions in the converter are not favorable as volatilization is reduced by the presence of basic materials such as PbO, MgO, Cu_2O and FeO. When FeS or CaO were added, volatilization was prevented entirely. A Cu-Sb slag was heated in a specially built steel retort in vacuum at 600° C. and over 50% of the Sb was volatilized. Sb may have been present in the slag as Sb_2O_3 or it may have formed in a secondary reaction from higher oxides with Cu_2O or small Cu particles. The process is not practical as Sb_2O_3 reacts with the steel retort wall. CEM (12a)

The Melting of Cast-Iron Rolls in the Electric Furnace (Das Schmelzen gusseiserner Walzen im elektrischen Ofen). L. Del Grosso. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, page 867.

The manufacture of finishing rolls, which are best made of a semi-hard cast iron with 2.5% C, has been found to give best results in the electric furnace. The rolls show denser and more uniform grains even in complex sections, a very fine and well distributed graphite and a pronounced pearlitic structure. Also, the mechanical properties were better than those of other materials. A 3-high mill equipped with such rolls gave a 32% higher production than when equipped with rolls from a reverberatory furnace. Ha (12a)

Casting & Solidification (12b)

The Craven Centrifugal Casting Machine. *Metal Industry,* London, Vol. 39, July 24, 1931, pages 83-84.

A description is given of the machine for centrifugally casting gear wheels, etc. PRK (12b)

On the Contraction of Copper-Tin Alloys. (Ueber die Schwindung von Kupfer-Zinn-Legierungen.) F. Böhm & F. Sauerwald. *Giesserei,* Vol. 17, Aug. 29, 1930, pages 841-849.

The contraction of various tin-bronzes on solidification after casting with varying conditions of cooling and in different gas atmospheres has been determined. See "Shrinking of Alloys," *Metals & Alloys,* Vol. 2, Nov. 1931, page 270. (12b)

Centrifugal Casting of Metals and Alloys. J. E. Hurst (Sheffield, Eng.). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 196-205.

The author points out the difference in the solidification of the centrifugal casting, which solidifies from one side of the section whereas the ordinary casting solidifies from both sides and leaves a more or less open center. The author discusses the centrifugal casting of cast iron and the properties obtainable with and without alloys. Microstructure of centrifugal castings and segregation therein are discussed. The method is best adapted to the production of hollow cylindrical castings. Equipment for production of casting by this method is described and discussed. WLC (12b)

Pouring of Aluminum Billets. (Vergiessen von Aluminium walzbarren.) P. Pontremoli. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 13, 1931, page 883.

Electric furnaces with neutral atmosphere are most suitable for melting of Al bars, as the metal should not be heated above 730° C. on account of its great tendency to absorb gases. The metal should remain in the furnace at from 670 to 680° C. to let the gases escape; the temperature should be increased to 760° C. just before pouring and care be taken that the metal does not go into the ladle at less than 700° C. To avoid segregations the temperature of the ladle should be kept below 300° C. Titanium additions give a finer grain and increase tensile strength and corrosion resistance; all electrical properties are improved except conductivity. The best results are obtained at temperatures of 730° C. at the beginning and 700° C. at the end of pouring, and at 250° to 300° C. of the outer surfaces of the ladle. The velocity of pouring is about 10 kg. of Al per min. A few hints as to ratio of dimensions of billets to ladle or mold are given. Ha (12b)

Water-cooled Ingot Molds; Construction, Operation, Results. (Wassergekühlte Kokillen; Konstruktion, Gebrauch, Ergebnisse.) K. Scherzer. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Dec. 4, 1931, page 922.

The defects of molds for pouring brass ingots are discussed and a water-cooled mold of Junker is described which avoids these errors. Results with other metals are reviewed. Ha (12b)

A Method for Determining the Volume Changes Occurring in Metals During Casting. C. M. Saeger, Jr. & E. J. Ash. *Bureau of Standards Journal of Research,* Vol. 8, Jan. 1932, pages 37-60.

This paper reviews the methods which have been proposed and used for determining the various types of shrinkage undergone by a cooling metal. See also *Metals & Alloys,* Vol. 2, Feb. 1931, page 43. WAT (12b)

Casting Chrome-Nickel Steel Requires Special Care. H. R. Simonds. *Steel,* Vol. 88, Apr. 23, 1931, pages 42-43.

Special precautions to observe for casting ornaments are discussed. Ha (12b)

Permanent Mould Foundry Practice for Bronze Castings. Henri Marius. *Metal Industry,* London, Vol. 39, July 24, 1931, pages 75-76; July 31, 1931, pages 103-104.

Condensed from paper presented before American Foundrymen's Association. Mention is made of the factors involved in the use of iron molds. See *Metals & Alloys,* Vol. 2, July 1931, page 135. PRK (12b)

Unsoundness in Aluminum Sand Castings. Part I. Pinholes: Their Causes and Prevention. D. Hanson & I. G. Slater. *Foundry Trade Journal,* Vol. 45, Sept. 24, 1931, pages 193-196; Oct. 1, 1931, pages 209-213; Oct. 8, 1931, pages 225-227; *Engineer,* Vol. 152, Sept. 25, 1931, page 331.

A paper read before the Zurich meeting of the Institute of Metals. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 312. LFM + OWE (12b)

Automatically Operated Molds for Die Castings. (Selbsttätig arbeitende Spritzgussformen.) Albert Kaufmann. *Maschinenbau,* Vol. 10, Mar. 19, 1931, pages 206-209.

For some complicated die parts, special structures are necessary. They are described, and the complete operation is possible with a high hourly output. MAB (12b)

Die-Casting as a Recent Manufacturing Method for the Shaping of Copper and Zinc Alloys (Das Spritzgussverfahren als moderne Fabrikationsart für die spanlose Verformung von Kupfer- und Zinklegierungen). R. W. Schulze. *Dinglers Polytechnisches Journal,* Vol. 346, May 1931, pages 82-84.

The latest advancements of die-casting extended to the relatively high melting Cu alloys and Zn alloys are reviewed. EF (12b)

The Manufacture of Sand-Spun Pipes. *Engineering,* Vol. 132, July 24, 1931, pages 93-96, 108.

Outlines method of the Staveley Coal and Iron Company, Limited, Chesterfield for casting pipe centrifugally. In this process, pipes are produced in sand molds rammed in cast-iron flasks rotated longitudinally while the molten iron is poured in. Rotation is continued until metal is completely solidified. Pipe cast by this process are entirely free from blow-holes, cavities and solid inclusions. Photomicrographs are given showing structure of the metal at the outer, center and inner edge of a sand-spun pipe and a pit-cast pipe. In the former the metal is more compact, the size of the graphite plates is more uniform and the proportion of pearlite is higher than in the pit-cast pipe. Due to the fact that cooling is slow proceeding from the outer surface in contact with the sand, internal stresses are avoided; the whole strength of the metal is available to resist the normal working stresses. A very complete description of the entire process including many illustrations is given. LFM (12b)

Rolling (12c)

Methods Used for Electrically Preheating Sheet Mill Rolls. A. J. Whitcomb. *Rolling Mill Journal,* Vol. 5, Nov. 1931, pages 733-736.

Types of electrical heaters for resistance or induction heating are described. See "Comparison of Methods Used for Electrically Preheating Sheet Mill Rolls," *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 45. Ha (12c)

Resistance to Deformation and Flow of Metal in Rolling. Erich Siebel. *Rolling Mill Journal,* Vol. 5, Mar. 1931, pages 205-208.

A study of the resistance encountered in the hot rolling of ordinary steel. Abstracted from a report of the Rolling Mill Committee of the German Iron and Steel Institute appearing in *Stahl und Eisen.* See *Metals & Alloys,* Vol. 2, Nov. 1931, page 270. JN (12c)

New Sheet Rolling Method Reduces Conversion Cost. *Steel,* Vol. 88, Jan. 15, 1931, page 41.

This article describes briefly and illustrates by diagram the respective lay-outs of 5 methods of hot rolling wide strip sheets. A chart is provided to show that 4 of these methods yield progressively greater savings in labor costs as compared to the first or old style Tipperary method. The article states that the newer methods are all in actual operation and available under license. JN (12c)

Rolling Temperature and Capacity of Merchant Mills. U. A. Peters. *Rolling Mill Journal,* Vol. 5, Sept. 1931, pages 601-602.

Mathematical expressions for determining the rolling pressure and time of rolling action in connection with the rolling temperature and capacity are derived. Mills finishing with a speed of 1500 ft./min. 12½% reduction. The determining factor for the speed of operation of a mill will be man-hours and kilowatt-hours per ton of steel rolled, factors which are better in the faster type of mills Ha (12c)

Electric Induction Roll Heating. R. J. Wean. *Rolling Mill Journal,* Vol. 5, Aug. 1931, pages 523-526, 558.

The disadvantages of preheating rolls by externally applied heat are explained and the construction of an induction coil laid around the rolls is described. The current induced in this manner in the interior of the rolls heats them up by hysteresis and eddy currents, and in exactly the same way as it takes place in actual rolling, that is the highest temperature is in the middle of the rolls decreasing towards the end. The advantages of this method are that the roll is gradually brought up to the required temperature by heat created in the roll itself; foundry and other interior stresses are relieved when the new roll is heated the first time, spare rolls can be kept hot in separate stands for immediate emergency, the heaters are put on Saturday nights, no attendance is needed; the rolls are covered to prevent radiation losses; the mill train always starts hot and power is saved by the reduced mill friction. The process is clean, and as it has a demagnetizing effect there is no likelihood of iron particles sticking to the rolls which might damage the sheets. Further, this electric load is used at off-times so that the current might be bought at a lower price. A roll heater takes about 50-60 KW. to raise the temperature of a pair of rolls 42 in. long by 30 in. diameter to 570° F. in 12 hours. Ha (12c)

Rolling Industry Adopting Many New Refinements. *Steel,* Vol. 88, Jan. 1, 1931, pages 289, 361.

The electrical developments in rolling mill practice for 1930 include the installation of one 4500 and two 5000 h.p. reversing motors in a universal slabbing mill, the first application of vertical motors in a continuous bar mill, the first installation of synchronous motors in hot tin mills, the development of automatic screw down control in rolling mills, the use of D. C. motor drives for bloom and slab shears, and the use of variable speed, shunt-wound motors for auxiliary mill drives. Other developments include normalizing furnaces, pack heating furnaces and levelers. JN (12c)

Electric Regenerative Drag for Sheet Mills. A. J. Whitcomb. *Freyn Design,* No. 9, Oct. 1931, pages 8-10.

A new electrical arrangement for the recovery of power, formerly lost in the friction drags used on sheet mill roll trains, resulted in a saving of $5400.00/yr. Ha (12c)

Effect of Loads on Ductile Metal. A. Nadai. *Rolling Mill Journal,* Vol. 5, Jan. 1931, page 54.

Paper presented at the annual convention of the American Society for Steel Treating. See "Concentrated Pressure and Some of its Applications to the Rolling Process," *Metals & Alloys,* Vol. 2, Oct. 1931, page 224. JN (12c)

Tin and Sheet-Mill Rolls—their Treatment, Performance and Premature Failure in Service. Eric R. Mort. *Blast Furnace & Steel Plant,* Vol. 18, July 1930, page 1180; Aug. 1930, page 1352; Sept. 1930, page 1502; Oct. 1930, page 1650; Nov. 1930, page 1732; Dec. 1930, page 1854; Vol. 19, Jan. 1931, page 156; Feb. 1931, page 298; Mar. 1931, page 446; Apr. 1931, page 582.

A full treatment of the subject from the operator's point of view. See *Metals & Alloys,* Vol. 1, Sept. 1930, page 737. Ha (12c)

The Automatic Mechanical Lubrication of Rolling Mills. W. D. Hodgson. *Rolling Mill Journal,* Vol. 5, Mar. 1931, page 219.

Abstract of a paper presented before the Association of Iron and Steel Electrical Engineers, Feb. 18. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 271. JN (12c)

Improvements in Sheet Mills (Neuerungen an Feinblech-Walzwerken). C. Hoffmann. *Stahl und Eisen,* Vol. 51, Oct. 15, 1931, pages 1283-1287.

The article describes recent constructions of sheet mills as developed by the Krupp-Gruson Works at Magdeburg-Buckau. An illustrated description of sheet and medium plate mills, of a continuous cold rolling mill and a 4-roll cluster mill for automobile sheets, including all special devices is given. GN (12c)

Driving Sheet and Tin Plate Mills. J. Selwyn Caswell. *Blast Furnace & Steel Plant,* Vol. 18, Oct. 1930, pages 1630-1631; Nov. 1930, pages 1712-1714; Dec. 1930, pages 1829-1833, 1835.

The mechanics and principles of the rolling process are discussed and the theory of determining the energy consumption for driving the rolls is developed. An example shows the energy required for individual passes for different operations in horse-power seconds. Ha (12c)

Forging (12d)

Hot Forging of Brass. *Metallurgist*, Mar. 1931, pages 47-48.
A review. VVK (12d)

Hollow Forging. E. V. T. ELLIS. *Engineering*, Vol. 132, July 10, 1931, pages 54-56.
Condensed from paper read before the Sheffield Society of Engineers and Metallurgists, April 20, 1931. LFM (12d)

Improved Quality and Reduction of Costs in Forging. (Gütesteigerung und Kostensenkung beim Schmieden.) H. KAESSBERG. *Maschinenbau*, Vol. 10, Feb. 19, 1931, pages 125-126.
The size of the field to which forgings may be applied is discussed together with the limitations with which it is surrounded due to uneconomical production methods. MAB (12d)

Prevention of Internal Strains in the Material during Forging and Rolling of Ingot Steel. (Verhütung von inneren Stoffspannungen beim Schmieden und Walzen von Flussstahl.) AUGUST FRIEDRICT. *Maschinenbau*, Vol. 10, May 21, 1931, pages 358-360.
It is indicated and proved by tests how unequal thickenings and stretchings and internal strains caused by them are brought about during forging and rolling of ingot steel just cast from the pig. They are due to deformation. The ways by which these phenomena can be avoided is explained. MAB (12d)

Hot Pressed Bodies of Certain Shape (Konstruktive bedingte Pressteile). E. SEMMLER. *Deutsche Motorzeitschrift*, Vol. 8, July 1931, pages 264-270.
Refers to Cu-Zn and Al-Cu alloys applied for hot-pressed machinery parts, and covers tensile strength, corrosion and wear-resistance, additions of Ni, Mn, Al, Fe, economic considerations and practical applications which are illustrated by 12 figs. and which mainly refer to the automobile industry. EF (12d)

Machining by Pressure. JOHN H. FRIEDMAN. *S. A. E. Journal*, Feb. 1932, pages 80-83.
Standards of accuracy in forging are subject to constant revision. Accuracy depends upon the equipment used and the limit of forging accuracy was thought to have been reached because of the structural limitations in machines of existing types. However, the development of a new type of pressure machine has again caused a revision of the ideas of the accuracy attainable. Finish forging on this machine can be done on the heat remaining from forging or annealing, at a temperature below that at which scale is formed. Cold coining is also done with this machine with a high degree of accuracy and uniformity. What may be referred to as pressure machining of forgings eliminates roughing cuts, reduces the number of handlings and, in some cases, entirely eliminates further machining. Other economics resulting from uniformity are the facility with which work fits into chucks, jigs and hoppers, and the uniformity in weight of parts. The machine is also used for straightening and sizing malleable castings and for hot forging both ferrous and non-ferrous metals. WAT (12d)

Shearing & Punching (12e)

Dies for Trimming Steel Shells. CHARLES M. BREHM (Steel Products Engineering Co.). *Machinery*, Vol. 38, Nov. 1931, pages 183-185.
Dies are so constructed that, at a single stroke of the power press, the trimming member is oscillated in several directions so as to trim the part completely. Often notching and piercing can be combined with the trimming in one operation. Various die constructions are described. RHP (12e)

Newly Devised Trimming Unit Speeds Shearing Operation. *Steel*, Vol. 88, Feb. 26, 1931, page 44.
Description of a new combination side and end slitting machine developed by the Yoder Co. of Cleveland for use in the sheet, tin and steel drum industries. The side trimming shear is placed at right angles to the end trimming unit. JN (12e)

Extruding (12f)

The Extrusion of Metals. C. A. COLOMBEL. *Rolling Mill Journal*, Vol. 5, Aug. 1931, pages 539-542; Sept. 1931, pages 599-600; Oct. 1931, pages 667-670; Nov. 1931, pages 719-722.
Extrusion defects encountered with non-ferrous metals and alloys and the methods of avoiding them are discussed; examples are cited. The extrusion of hollow sections, especially that of round tubing, and the principles and practice employed in extrusion and drawing of non-ferrous tubing are discussed. Ha (12f)

Machining (12g)

New Investigations on the Theory of Cutting and Machinability. (Neue Untersuchungen zur Schnittheorie und Bearbeitbarkeit.) *Stahl und Eisen*, Vol. 51, Sept. 10, 1931, pages 1148-1150.
Discussion by H. Klopstock, S. Patkay and G. Schlesinger on a paper by F. Schwerd with the above title which appeared in *Stahl und Eisen*, Vol. 51, Apr. 16, 1931, pages 481-491. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 19. GN (12g)

How Tools of Tantalum Carbide Show Remarkable Cutting Properties. *Steel*, Vol. 89, July 23, 1931, page 35.
A few examples are related where tantalum carbide (Carboloy) tools cut metal where ordinary tool steels could not make an impression. Ha (12g)

Tantalum Carbide Tools Show Unusual Cutting Capacity. *Steel*, Vol. 88, Feb. 26, 1931, pages 52-53.
A short description of the history, properties, manufacture and extraordinary cutting power of Ramet, a new hard cutting metal for machine tool tips produced by the Fansteel Products Co. Ramet has a tensile strength of 250,000 to 300,000 lbs./in.^{2}, a Rockwell hardness of 88.5 to 90.5, and a melting point of 7952°F. The tips of Ramet are brazed to lathe tools, saws, milling cutters, drills, etc. This metal will machine properly all steels, high-Mn steels and hardened tool steels, as well as cast iron, C steels, Al, bakelite, etc. JN (12g)

A New Method of Boring in Manufacturing Tools (Ein neues Bohrverfahren für den Werkzeugbau). J. BRANDL. *Das Werkzeug* (supplement to *Maschinenkonstrukteur-Betriebstechnik*), Vol. 7, June 10, 1931, pages 123-124.
Descriptive. MAB (12g)

Action of Widia Cutting Tool Studied by High-Speed Photography. F. SCHWERD. *Iron Age*, Vol. 128, July 23, 1931, page 249.
Abstract translation of an article in *Stahl und Eisen*, Vol. 51, Apr. 16, 1931. See "New Investigations on the Theory of Cutting and Machinability," *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 19. Ha (12g)

Testing of Gray Cast-Iron for Machineability. (Prüfung von grauem Gusseisen auf Bearbeitbarkeit.) R. MEI. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, page 923.
The castings used for typewriters must be easily machinable. The foundry of Olivetti has developed a formula from a certain method of testing by drilling holes which gives each quality of casting a number directly proportional to the velocity of drilling under definite conditions, and therefore for the machinability. Ha (12g)

Cemented Tantalum Carbide, a New Tool Material. *Metal Progress*, Vol. 19, Mar. 1931, pages 53-55.
This new tool material is described and its applications discussed. WLC (12g)

What We Have Learned about Tungsten Carbide. F. W. CURTIS. *Machinery*, Vol. 37, July 1931, pages 867-869; Aug. 1931, pages 938-940.
By reviewing the present experiences with this material, 10 fundamental rules regarding proper use and methods are developed. Ha (12g)

Machine Tools for Light Metals. (Werkzeugmaschinen für Leichtmetallbearbeitung.) PH. KELLE. *Zeitschrift für Metallkunde*, Vol. 23, Nov. 1931, pages 309-313.
Tungsten carbide tools have proved most satisfactory for machining light metals containing Si (Silumin, Alusil); for other light alloys high-speed tool steel is satisfactory. Machine construction for machining light alloys is discussed in detail and illustrated by diagrams and photographs. The grinding of tungsten carbide tools is discussed. RFM (12g)

Tool Steel Specification. H. G. KESHIAN. *Metal Stampings*, Vol. 4, Nov. 1931, page 878.
The present methods of selecting a tool steel are critically reviewed. It is found that, while users of steel for mechanical and structural purposes have definite specifications of their requirements, the user of tool steel usually applies only general terms, such as "keen cutting edge," "toughness," etc. The possibility of the achievement of a similar definiteness in specifications for tool steels is questioned. Ha (12g)

The Broadening Field of Tungsten-Carbide Tools. J. A. MARKSTRUM. *Machinery*, Vol. 37, Mar. 1931, pages 511-515.
Milling cutters, drills, forming tools, counterbores, etc., are now fitted with carboloy tips; several are shown. Ha (12g)

Measurement of Cutting Pressure on Tool Cutting Edges. (Schnittdruck-Messung an Werkzeugschneiden). GEO. KEINATH. *Archiv für Technisches Messen*, section V132-2, 1931, page T6.
In order to measure the three components of the cutting pressures of a tool during cutting, that is the tangential, radial and axial component, the condenser measuring box has been devised. Two plane-parallel steel disks form an air condenser which is, in the box, placed between the tool and the support. The pressure exerted by the tool changes the airgap between the 2 steel discs and, as the condenser forms part of a tuned oscillating circuit, disturbs the balance in the latter. The current is amplified and can be used to make a record of the disturbing quantity which is a measure for the pressure. Method and curves are illustrated; literature references are given. Ha (12g)

Economics in Turning, Planing and Slotting. (Wirtschaftlichkeit bei Dreh-, Hobel- und Stossarbeiten.) W. FEHSE. *Maschinenbau*, Vol. 10, Feb. 19, 1931, pages 114-117.
The ways by which the quality of the work done in turning, planing and slotting can be improved with simultaneous reduction in costs is discussed. Making use of the coöperation of technical societies, use of technical literature, etc., is recommended. Certain problems concerning machines, tools and parts, can be solved by the Bureau on construction and machining. The advantages of using hard metal, high speed steel and hydraulically operated machines are pointed out, and examples are cited. MAB (12g)

An Investigation of Methods to Determine the Machineability of Malleable Iron Castings. O. W. BOSTON. *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 2, 1931, pages 388-421.
Includes discussion. Extended discussion of machinability tests made by measuring the force required to cut in planing, milling and drilling. The ferritic surface of the casting machines with comparative ease. At 0.015 to 0.05 in., greater difficulty is encountered. At still greater depths, machining is easy. In discussion, Schwartz pointed out that the criterion of machineability in which the user of malleable is interested is tool life, not power consumption. HWG (12g)

Results of Cutting Pressure Measurements in the Machining of Various Kinds of Steels. (Ergebnisse der Schnittdruckmessung bei der Zerspanung verschiedener Stahlsorten). F. RAPATZ. *Stahl und Eisen*, Vol. 52, Jan. 7, 1932, pages 17-18.
Former tests showed that the cutting pressures are independent of the rate of machining, as well as of the boring depth, and decrease only slightly with the feed. Steels for automatics, with a small feed are easier to machine than soft ingot steels, since they require a small amount of shaping work. The writer contends that it is erroneous to use cutting pressure methods as a means of determining all effects. Following results were obtained in the comparison of the machinability of cast iron and steel by the use of high speed C steel and Widia metal tools, boring depth 4 mm. and 1 mm. feed.

	Cutting speed in m/min.		
	Steel of T.S.	Cast Iron of Brinell Hardness	
Tools made of	55 kg./mm.^{2}	203	180
High speed steel	37	18	28
Widia metal	82	108	over 200

GN + DTR (12g)

Drawing & Stamping (12h)

The Production of Sheet Containers. Part II. S. D. Brootzkoos. *Metal Stampings,* Vol. 4, May 1931, pages 415-418, 425-426.
The author describes the following operations in the manufacture of tin cans: cutting tin sheet into required sizes for body blanks with automatic gang slitters; forming the can body in the can body making machine; soldering of the side seam; and forming the flanges on each end of the can body by means of the double end flanging machine. JN (12h)

Testing Drawing Qualities of Aluminum Sheets. R. J. Anderson. *Machinery,* Vol. 37, Mar. 1931, pages 494-495.
Tables which are developed from numerous cupping tests conducted to obtain data of aluminum sheets of different degrees of hardness and of varying thickness are given. The machine for making the cups is described. Ha (12h)

Deep-Drawing a Tubular Steel Spoke. E. H. Arnold. *Iron Age,* Vol. 128, Dec. 10, 1931, page 1534.
The subject is approached especially from an educational standpoint to show not only what has been done, but what can be accomplished with steel in producing a tubular steel spoke. In making the spokes, the author used ordinary soft cold rolled steel. The method used in making them is described. VSP (12h)

Cold Stretching Apparatus. (Kaltstreckapparat.) J. Blume. *Die Metallbörse,* Vol. 21, Jan. 1931, page 102.
The author points out the difficulties associated with the tapering of thin wires and calls attention to a recent device which hammers on the cone or point by means of two rotating halves of a mold. The apparatus is illustrated and explained. EF (12h)

Commercial Types of Power Presses. Part IV. Drawing Attachments Employed on Single Action Presses. Part V. Cam Drawing Presses. E. V. Crane (E. W. Bliss Co.) *Metal Stampings,* Vol. 4, May 1931, pages 409-413; June 1931, pages 497-500.
Drawing attachments are used on single action crank presses for holding the blank flat on the die during the drawing operation. The die employed is of the double action inverted type. Springs and rubber bumpers exert a blank-holding pressure which rises as the draw progresses. A uniform drawing pressure is highly desirable as this condition greatly reduces breakage losses. Several types of mechanical devices are designed to equalize or compensate for rising pressure. The air cushion is the most modern and most satisfactory type of blank-holding attachment as it permits the application of a uniform pressure throughout the drawing stroke.
Because of the great difference in the amount of work done by the two presses in blank holding, the double action press requires less power for a given drawing operation than does the single action press equipped with blank holding attachments. The author discusses several types of double action cam drawing presses and illustrates two types of presses and two types of double action dies used with them. JN (12h)

The Advantages of Uniformity in Cutting and Stamping Machines. (Vorteile der Vereinheitlichung beim Schnitt- und Stanzenbau.) A. Peterhans. *Maschinenbau,* Vol. 10, Feb. 19, 1931, pages 119-122.
The lines which are followed out in stamping technic are discussed and economically evaluated by a committee on economic production. MAB (12h)

Copper Wire Production on Continuous Machines. Wm. D. Pierson. *Wire & Wire Products,* Vol. 6, Dec. 1931, pages 470-472, 489.
The means for producing a desired quantity of copper wire and a method of estimating production results to be expected in drawing copper wire are discussed. The necessary equipment can be determined by taking into account carefully all the local conditions. An example illustrates the manner of procedure. Ha (12h)

Deep-Drawing Lubricants. Maurice Reswick. *Metal Stampings,* Vol. 4, Oct. 1931, pages 831-832.
The principal ingredients of deep-drawing lubricants are tallow, mineral oil, water and fillers like chalk, soapstone, mica, rosin, fire-clay, etc. Their characteristics and compositions are discussed. The principal requirements are strength of film, oiliness, adhesiveness and spreading, ease of cleaning, non-corrosiveness, stability and uniformity, odor and economy. They must not have any physiological effects on the machine operator. See also "Lubricants for Deep Drawing," *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 20. Ha (12h)

Measures of Die Performance. J. R. Longwell. *Wire & Wire Products,* Vol. 7, Jan. 1932, pages 16-17, 24-25, 28.
The various factors entering into wire drawing costs, as material drawn, die shape, lubricant, speed of drawing, are discussed, and a performance table is given for different gages. The cemented carbide dies are economical in use with proper considerations of the factors mentioned before. An economic factor of importance is the production per machine man. Ha (12h)

Comparison of Sheet and Strip Steels for Difficult Stampings. Edward S. Lawrence (Duraloy Co.). *American Society for Steel Treating, Preprint* No. 11, 1931, 21 pages.
Paper read and discussed at the Boston Convention of the Society in Sept. 1931. 53 references to the literature are cited. The differences in the manufacture of sheet and strip for deep and extra deep drawing automotive stampings are discussed. The defects and limitations of each material for this purpose are brought out. The adaptability of strip steel is discussed. Various physical standards now demanded by sheet and strip users are criticized. Coöperation between the producer and user in their research and development is urged. WLC (12h)

Sheet and Strip Steel for Difficult Stampings. Edw. S. Lawrence. *Metal Stampings,* Vol. 4, Oct. 1931, pages 811-812, 832.
Low C strip and sheet steels in wide, thin gages as used for difficult stampings and deep-drawing are discussed. The setting of presses, distances between punch and die are considered. Instead of the present general chemical and physical specifications, the author believes that properties for operation in such presses should be specified. Ha (12h)

Pickling (12i)

New Pickling Method Gives Thorough Scale Removal. *Steel,* Vol. 88, Mar. 12, 1931, page 51.
The Hanson-Munning bright-dip method uses 2 tanks, one containing an acid solution kept at from 120° to 150° F. Electrodes in this tank supply a current to the piece of 100 amp./ft.^{2} of surface to be cleaned at 6 volts. The second tank contains another acid solution at a slightly lower temperature than the first one, and here the current flows from the piece to the electrodes at 150 amp./ft.^{2}. The electrodes are of an insoluble lead composition. Light scale is removed in less than 5 minutes, forgings with resistant scales in 5 to 10 min. The exact procedure with subsequent rinsing is described. Ha (12i)

Pickling and Burnishing (Beizen und Brennen). H. Kurrein. *Chemikerzeitung,* Vol. 55, Feb. 18, 1931, pages 133-134; Feb. 25, 1931, pages 150-151.
The chemical principles of pickling and burnishing are explained and the various reagents for different metals are described. The practical applications are discussed. Electrochemical pickling, with or without exterior current source, anodically or cathodically, is recommended for special purposes. Pickling can be combined conveniently with degreasing. Ha (12i)

Pickling for Plating. C. M. Hoff. *Iron and Steel of Canada,* Vol. 14, Sept. 1931, pages 144-146, 153.
An article in which the purpose of pickling is briefly discussed and attention then directed to the acids normally used in pickling and the characteristics of each. Space is devoted to a discussion of the chemistry of pickling and to new developments in this field. The question of acid embrittlement is dealt with briefly, and the value of inhibitors in preventing embrittlement is pointed out. OWE (12i)

The Pickling and Cleaning of Metals. Some Considerations of the Chemical Reactions Involved. David Brownlie. *Sheet Metal Industries,* Vol. 4, Jan. 1931, pages 768-770; Feb. 1931, pages 862-864; Mar. 1931, pages 938-940.
Part V. The use of nitre cake in a 25% hot solution resulting in 6-8% free sulphuric acid is discussed but is considered as not being a paying proposition when calculated against sulphuric acid. Cleaning by the use of alkalies and alkaline salts is treated. Part VI. Discussion of tank linings and the development of mechanical aids in the pickling of metals. The use of rubber compounds as linings is lauded. Part VII. The development of submerged combustion methods is discussed. The advantages suggested in the application, cheapness of equipment, high rate of heat transmission and continuous circulation and mixing of the pickling liquor coupled with a strong "scrubbing" action. AWM (12i)

Cleaning Before Pickling. Wallace G. Imhoff. *Iron and Steel of Canada,* Vol. 14, Oct. 1931, pages 158-159, 165.
The author discusses very completely the various methods that may be adopted for cleaning articles before pickling. The advantages of tumbling are discussed in some detail, and the value of mechanical washing machines for cleaning off oil and grease is referred to. The need for careful study before a decision is made in regard to the installation of any cleaning equipment is emphasized. OWE (12i)

Cold Working (12j)

The Manufacture of Cold Drawn Steel. Earl D. Townsend. *Rolling Mill Journal,* Vol. 5, Mar. 1931, pages 195-200, 204.
The first cold drawn steel products were wire musical strings, bicycle wheel spokes, etc., manufactured in Germany. Later cold drawn steel wire was manufactured in Beaver Falls, Pa. The early workers used solid dies. The first sectional die, the forerunner of our present-day dies for cold drawing everything except rounds, was designed by Stephen Moltrup. There are 2 types of draw benches for holding the die and cold drawing the metal. The most widely used type, the chain bench, employs a chain and sprocket for transmitting the drawing power while the rack bench uses a rack and pinion mechanism. Bars are usually drawn through dies at a speed of 20-50 ft./min. for large bars and 60-120 ft./min. for small bars. The drawn bars average 40 ft. in length. Dies are made of hardened C steels, alloy steels, carboloy, etc. For drill rod and hard round wire, black diamonds or other precious stones are used. Cold drawn steel bars are used for bolts, nuts, screws, spindles, shafting, etc. Coiled wire is drawn in a wire block, which differs from a draw bench in having a winding drum instead of a carriage. Seamless material is used for drawing finished pipe or tubes. The draw bench employed is equipped with a mandrel and an adjustable rod holder. Cold drawn seamless steel tubing is used for hypodermic needles, piston cylinders, trolley poles, cream separator barrels, roller bearing races and automotive parts. The tubing produced may be round, square, hexagonal, flat, half-round, etc. Some new products made of cold drawn seamless steel tubing are airplane struts and poles for carrying electric wires. JN (12j)

The Interpretation of the Texture of Cold-Deformed Metals (Zur Deutung der Textur kaltverformter Metalle). W. E. Schmidt. *Zeitschrift für technische Physik,* Vol. 12, Nov. 1931, pages 552-555.
The interpretation hypothesis on the texture of cold deformed metals developed by W. Boas and E. Schmidt is critically discussed and the assumptions made by F. Weber and W. E. Schmidt are emphasized. EF (12j)

Strip Tempers Modified by Rolling after Annealing. Jos. S. Adelson. *Steel,* Vol. 88, Mar. 5, 1931, pages 50-53; Mar. 19, 1931, pages 40-46.
The process of manufacturing cold strip, the different temper ranges and the types of testing machines are described in a general manner; physical characteristics and tests results are tabulated. Ha (12j)

The Cold Roll Forming of Rust-Resistant Metals. D. A. Johnston. *Metal Stampings,* Vol. 4, Oct. 1931, pages 815-816.
Typical applications of different sections cold-roll-formed from Cu, Al, Al alloys and rust-resisting steels are described and illustrated. Ha (12j)

Cleaning (12k)

Degreasing in the Chrome-Galvano-Technique. (Die Entfettung in der Chrom-Galvanotechnik.) Richard Justh. *Oberflächentechnik*, Vol. 9, Jan. 5, 1932, pages 3-4.

The importance of absolutely grease-free surfaces for electroplating or coloring of metals is pointed out, and the defects resulting from a lack of this precaution and the means to obtain a proper surface are discussed. Ha (12k)

Equipment for the Cleaning of Metal. R. W. Mitchell. *Metal Cleaning & Finishing*, Vol. 3, Jan. 1931, pages 13-26; Feb. 1931, pages 107-115; Mar. 1931, pages 195-204; Apr. 1931, pages 287-294.

These articles constitute a comprehensive review, with illustrations of plants and equipment, of advantages and applications of wood, steel and iron tanks, lead and rubber lined tanks and vitreous enameled iron and steel tanks for cleaning and pickling solutions, of stone ware, concrete, acid-proof brick, monel metal and aluminum tanks. Tank location, drainage systems, siphons, overflow dams, ventilators, tank covers and general points to be observed in cleaning plants are discussed. Ha (12k)

Faulty Cleaning of Steel Determines Failures in Enamel Finishes. *Steel*, Vol. 89, Oct. 12, 1931, page 36.

In order to preclude the possibility of the development of local or general rust under the enamel, it is important to remove any trace of alkali which was used in cleaning. Ha (12k)

Newer Methods for Cleaning Oily Metal Parts in Industrial and Technical Processes (Neuere Verfahren zur Reinigung fettiger Metallteile in industriellen und gewerblichen Betrieben). Hermann Stadlinger. *Chemiker Zeitschrift*, Vol. 54, May 7, 1930, pages 354-355.

Various methods are briefly described. A new cleaner, "P33", sold in powder form by Henkel & Co., consists of a mixture of low alkali water glass and sodium phosphate. While not strong enough to injure the skin of workmen, a boiling 5% solution readily removes oil and dirt from metal. More time is required to remove some easily saponified oils than mineral oil. Hence, its action is to emulsify rather than to saponify. Experiments show that it will not corrode Al, Zn, etc. There is also a special grade which does not attack tin-plate, brass or duralumin. By the use of special metal-washing machines, 1-4% solutions at 80° to 90° C. will serve, depending on the kind of oil and dirt. There is no fire or health hazard. See also "Recent Methods for the Cleaning of Greasy Metal Parts in Industrial Operations," *Metals & Alloys*, Vol. 2, Nov. 1931, page 272. (12k)

Polishing & Grinding (12l)

Causes of Cracks in Hardened Steel. C. E. Sweetser. *Abrasive Industry*, Vol. 12, Sept. 1931, pages 21-24; *Steel*, Vol. 89, Sept. 24, 1931, pages 31-34.

Occurrence of cracks in the ground surfaces of hardened steels under seemingly normal conditions of manufacture is caused either by heat treatment or by grinding. The real problem is to distinguish between these 2 causes. The results of a test are reported and discussed. A comparatively severe degree of grinding abuse is required to crack steel which has been properly heat treated. On the other hand, steels which have been subjected to extremely severe heat treatment may be cracked with little, if any, abuse by grinding. Cracks may be identified with their causes by observing their size, form, number and location after etching. Those which are few in number and comparatively wide and deep point to abuse in the heat treating process as the predominating cause. Cracks which occur in the form of a fine surface network indicate incorrect heat treatment and decidedly abusive grinding. Ha+WAT (12l)

Grinding Lithograph Plates. *Abrasive Industry*, Vol. 12, Oct. 1931, page 19.

The abrasive used is fine-grit silicon carbide although emery and silica sand are used in some instances. Abrasive action is brought about by steel balls ⅜ to ½ in. in diameter. With the plate in position, the abrasive grain and the balls are placed on it and enough water is added to "float" the abrasive. The bed is set in motion and as it oscillates, the inertia of the comparatively heavy balls brings about an abrasive action which imparts the correct mat surface for lithographic printing. The size of abrasive used determines the texture of the surface. Either coarse-grained or fine-grained surfaces can be produced, depending on the size of grain employed. The abrasive is replaced every 20 or 30 min. If the abrasive were used continually it eventually would be ground into a fine sludge by its own action and thus produce a mat surface too fine for practical purposes. WAT (12l)

Wheels for Smooth Finish, Carborundum Co. *Abrasive Industry*, Vol. 12, Sept. 1931, page 28.

Solid grinding wheels capable of producing extremely high finishes formerly attainable only by lapping with compound or other loose-grain agencies are being made. To develop such a grinding wheel, it was first necessary to produce uniform grain or grits of the finest sizes. Both aluminum oxides and silicon carbide are used in making these wheels, depending upon the character of the material to be finished. These powders are said to be as perfectly uniform in individual grit size as science and skill can make them. Grinding machine manufacturers have perfected their machines practically to eliminate vibration. The finishes required must be the result of a progression, a building up of comparably finer finishes with a series of progressively finer wheels and a consequent diminishing stock removal to prepare the surface for the final finish. The new type of wheels are not expected to go production grinding in the sense of the removal of large amounts of metal. WAT (12l)

Stresses and Cracks in Hardened and Ground Steel. G. R. Brophy. *Metal Stampings*, Vol. 3, Oct. 1930, pages 933-934.

Abstract of paper read before the American Society for Steel Treating, Sept. 22-26, 1930. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 21. MS (12l)

Centerless Grinding of Bars and Tubes. (Das mittelpunktlose Schleifen von Stangen und Rohren.) W. Loewe. *Stahl und Eisen*, Vol. 51, Dec. 31, 1931, pages 1616-1618.

A centerless grinding machine is described and its advantages are discussed. After dealing with capacity and efficiency of the new machine the technical suppositions for economically grinding bars and tubes are discussed. It is pointed out that centerless grinding proves superior to any other grinding method for grinding rust and heat resisting steels. Data are given on the tolerances of the above method. GN (12l)

Polishing Aluminum. W. E. Warner. *Canadian Machinery*, Vol. 42, Oct. 15, 1931, page 32.

Aluminum can be successfully polished to a high finish provided certain precautions are taken. Owing to the softness of the metal as compared with other metals the polishing wheels used should be softer. The abrasive must be finer and have a gentler cutting action. The wheel speed must also be lower. Owing to its high coefficient of friction, the metal has a tendency to heat, which will result in the polishing wheel burning. This is only prevented by keeping the wheel speed low and by using plenty of lubricant. The first operation should be done on a canvas or rag wheel, using No. 60 to No. 100 emery as the abrasive. The wheel speed should not be greater than 6,000 ft./min. WAT (12l)

Grinding, Lapping, or Running-in Cog Wheels? (Schleifen, Lappen oder Einlaufen von Zahnrädern?) Robert Hofmann. *Maschinenbau*, Vol. 10, Mar. 5, 1931, pages 174-177.

Based on operating practices and current investigations, cog wheels produced and treated by a variety of methods are compared. Conclusions and recommendations for practice are drawn from the results. MAB (12l)

Finishing Gears. Rob. Hofmann. *Automobile Engineer*, Vol. 21, Aug. 1931, pages 305-307.

Grinding, burnishing and lapping as final operations for parts of extreme accuracy are discussed and particular reference is made to involute gears. Curves taken with the Maag center distance and concentricity apparatus illustrate inaccuracies and profiles of correctly ground gears are shown. (12l)

Coloring (12m)

Coloring of Cadmium Coatings. (Färbung von Kadmiumniederschlägen.) H. Krause. *Zeitschrift für Metallkunde*, Vol. 23, Oct. 1931, pages 283-285.

A deep black, tight deposit can be produced on Cd plating by immersion in a solution of $KClO_3 + Cu(NO_3)_2$. A brown deposit may be obtained by $KMnO_4$. Corrosion tests in 20% NaCl solution in water showed the brown deposit not to affect the corrosion resistance of the plating, but the black deposit noticeably to reduce it. RFM (12m)

Molybdenum in Coloring of Metals. (Das Molybdän in der Metallfärbung.) Geo. Buchner. *Oberflächentechnik*, Vol. 9, Jan. 19, 1932, page 14.

A few methods, mostly patented, are described by which metals can be given a surface coloring of yellow, orange, blue, black, by dipping the articles in pure Mo solutions of ammonium alone or with additions of oxalic salts, fluorides, tungstic acid and others. The Mo solutions are used in a strength of ½ to 1%; the article is made the cathode in the solution. Ha (12m)

Sand Blasting (12n)

Circulating Dust Removal and Cleaning of Dusty Air for Sandblast Blowers. (Kreislaufentstaubung und Staubluftreinigung bei Sandstrahlgebläsen.) U. Lohse. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, pages 913-915.

The removal of the sandblast dust is necessary not only for sanitary reasons but also because the operator can do better work in a clean atmosphere. Proper arrangement of pure air supply, illumination, general arrangement of the blast house is discussed and illustrated by a few plants. Ha (12n)

Silicosos and Foundry Sand Blasting. *Metal Industry*, London, Vol. 39, July 24, 1931, page 84.

A special flint grit abrasive of non-crystalline character is reported as being dustless and so prevents sickness losses due to Silicosis. PRK (12n)

Modern Applications of Sand-Blast Plant. T. Fearnley Allen. *Foundry Trade Journal*, Vol. 45, Dec. 17, 1931, pages 382-384.

Description of the various types of sand-blast plant now in use. Consideration is given to the consumption of air in the ordinary cleaning of gray iron castings, and attention is directed to the high pressures required for the preparation of castings for vitreous enamelling. Reference is made to the more satisfactory types of exhaust systems and to the various abrasives that have come into use in this connection. Attention is directed to the fact that to a great extent steel has replaced sand due largely to the Silicosis Regulations of the British Home Office authorities. The various applications of sand-blasting are discussed in some detail, and the use of the sand blast as a means for testing stone, wood, or composition for street paving or flooring is referred to. The article is accompanied by 3 photographs. OWE (12n)

Spinning (12p)

Improved Procedure is Outlined for Spinning Chrome-Nickel Steel. J. R. Morris. *Steel*, Vol. 89, Sept. 17, 1931, page 33.

An 18-8 alloy is used for spinning, it requires less annealing than any other stainless steel. Annealing, when required, should be done at 2000° to 2050° F. Tools are preferably of a Ni-Cr cast-iron with 3% C, 2.5 to 3% Ni, 0.75 to 1% Cr and 1.2 to 1.5% Si. Water soluble lubricants are recommended. Ha (12p)

Spinning Covers a Special Machine. F. C. Hudson. *American Machinist*, Vol. 75, Sept. 3, 1931, page 386.

Detailed description of a semi-automatic spinning machine, built-up by welding. Ha (12p)

DEFECTS (13)

Searching for Flaws in Rails. *Railway Age,* Vol. 92, Jan. 30, 1932, pages 194-196.

After years of study and close coöperation with the late E. A. Sperry, in the development of the transverse fissure detector, the New York Central Railroad has placed in operation a detector car of its own, which incorporates the latest features in the art of rail flaw discovery. This new car differs in very many respects from anything of its kind ever built. It meets all the requirements of the signal department, contains its own motive power, weighs 150,000 lbs. and is equipped with automatic train control. The range of speed varies from 5-55 miles per hour. It contains complete living quarters as well as certain equipment maintenance facilities. The record compartment is approximately 19 ft. long. Complete details of how defects are detected are presented. When a defective rail is found it is given a serial number and a record is made of its exact location as well as the name of the manufacturer, date rolled, heat number, etc. These rails are replaced immediately by tested rails. WAT (13)

New Method for the Detection and Recording of Rivet Hole Cracks. (Neue Methode zur Auffindung und Darstellung von Nietlochrissen.) H. Stehr. *Die Wärme,* Vol. 53, Sept. 27, 1930, pages 730-731.

The occurrence and detection of cracks around rivet holes is discussed and the author outlines his newly invented method of determination. A sulphide solution is brought upon the surface to be tested. Due to the capillary effect, part of the solution is sucked even into the smallest crevices while the rest is being removed from the surface. Next a silver bromide paper soaked in H_2SO_4 is pressed against the metal sheet. Black silver sulphide is formed at the cracks thus yielding a true copy of the defects, which can be evaluated quantitatively. EF (13)

Investigation into the Cause of a Crack Formation between the drilled Tube Holes of a Vertical Tube Boiler. (Ermittlung der Ursachen eines Risses zwischen den Bohrlöchern eines Steilrohrkessels.) Schuhmacher. *Die Wärme,* Vol. 54, Sept. 12, 1931, pages 689-693.

The micro-structural examination disclosed an improper heat treatment of the boiler material resulting in a failure due to aging. EF (13)

The Influence of Impurities in Foundry Brasses and Bronzes. H. M. St. John (Detroit Lubricator Co.). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 242-245.

31 references. The author has summarized the literature on the subject of impurities in brass and bronze foundry alloys. Impurities are classified as gases, metallic and non-metallic impurities. These classes are discussed as such and then specific elements, gases and non-metallics are discussed individually. WLC (13)

Investigation of the Failure of a Copper Fire-Box (Untersuchung über Rissbildung bei kupferenen Feuerbüchsen). O. Schroeder. *Glasers Annalen,* Vol. 55, July 1, 1931, pages 6-8.

A chemical and metallographic investigation on a fire box, which developed cracks during the repair work by welding, disclosed the presence of copper oxide as the cause of the failure. EF (13)

Scabs in Castings Traced to Molding Sand Defects. *Steel,* Vol. 88, June 18, 1931, page 53.

Brief review on several papers on this subject of a French Convention. Ha (13)

Distribution of Oxide and Sulphide Inclusions in Steel. Correspondence from W. Zieler, Düsseldorf, Germany. *Metal Progress,* Vol. 21, Feb. 1932, pages 68-69.

The writer discusses the difference in the locations of oxide and sulphide inclusions in steel ingots. WLC (13)

Grain-Growth in a Turbine Wheel Heated by Friction. *Engineering,* Vol. 131, June 12, 1931, page 752.

Failure of a steam turbine was caused by the deformation of a cast-iron diaphragm which touched the adjacent wheel which raised the temperature causing recrystallization of the steel. Photomicrographs are given showing the granular structure of the steel. LFM (13)

Failures of Rails. (Schienenbrüche bei ausländischen Eisenbahnverwaltungen.) W. Marzahn. *Stahl und Eisen,* Vol. 51, Nov. 5, 1931, pages 1377-1379.

The article gives a résumé of the results of questionnaires compiled by various railroad administrations. (See Cambournac & Patte, *Bulletin de l'Association Internationale du Congres des Chemins de Fer,* Vol. 11, 1929, pages 923-1024.) The failures due to segregations, the so-called nodular fractures, longitudinal fissures in the flange and faults of the surface are discussed. The results of a comprehensive investigation on nodular fractures by S. Ikeda published in *Bulletin de l'Association du Congres Internationale des Chemins de Fer,* Vol. 11, 1929, pages 2506-2518 and carried on by the Research Department of the Japanese Government Railway are given. Ikeda is of the opinion that this transverse fracture is some kind of a fatigue which starts in the interior of the rail. The reviewer states that the origin of the nodular fractures is stresses which are developed on the hot bed or during straightening the rails. Longitudinal fissures were frequently observed during the extremely cold winter of 1929 in France, Germany, Sweden and other countries. These failures are actually due to extreme cold. An investigation of the corrosion of rails has also been carried out by the Research Department of the Japanese Railway as reported by E. Matsunawa in *Bulletin de l'Association Internationale du Congres des Chemins de Fer,* Vol. 11, 1929, pages 1329-1349. This author found that sea air corrodes as well as the ash of the Japanese oils used for driving the engines. Corrosions of rails in tunnels is due to the increased content of SO_2 in the air. Remedies suggested are to drop water containing Na_2CO_3 upon the rails in order to neutralize the acid; to suck the combustion gases out of the tunnel by means of an exhaustor; and to use rails containing copper. GN (13)

CHEMICAL ANALYSIS (14)

The Analysis of Coating of Galvanized Sheet Steel. (Fe, Pb, Cd, Sn and Zn). Frank W. Scott. *Chemist-Analyst,* Vol. 20, Mar. 1931, pages 4-5.

Three samples, 2¼" square, are cleaned, dried and weighed and placed in a 400 cc. beaker, their bottom edges resting on c.p. Zn. The samples are covered with 1:10 H_2SO_4 until the action ceases, about 10 min., when the acid is replaced with H_2O. The samples are scrubbed with a policeman, dried and weighed. Fe in the solution is reduced and titrated with $KMnO_4$. HNO_3 and H_2SO_4 are added to the solution and it is evaporated to fumes, adding crystals of $(NH_4)_2SO_4$. After diluting, $PbSO_4$ is filtered and weighed on an asbestos mat. The filtrate is heated to boiling and H_2S passed through. NH_4OH is added until CdS and a little ZnS precipitates. After filtering, the sulphides are dissolved in 100 cc. 1:9 HCl, neutralized with NH_4OH, 6 cc. HCl is added and H_2S again passed through. A few drops of NH_4OH are added to start precipitation if necessary. The sulphides are filtered, dissolved in 1:1 H_2SO_4 and CdS is reprecipitated with H_2S after adding 5 g. NH_4Cl and diluting to 400 cc. CdS is filtered and weighed on a Gooch crucible. For the Sn determination three more samples are stripped using 1:5 HCl. H_2S is passed through the solution and it is half neutralized with NH_4OH and diluted to 450 cc., continuing the H_2S treatment. The sulphides are filtered with the aid of paper pulp and dissolved in 10 parts 1:1 HCl and 1 part HNO_3. After boiling and diluting to 200 cc. the solution is almost neutralized with NH_4OH, using methyl orange. An excess of ammonium acetate is added and the solution is allowed to stand in a warm place until gelatinous $Sn(OH)_2$ separates. It is filtered, using paper pulp, ignited and weighed as SnO_2. Zn is taken by difference. CEM (14)

Chemical Analysis of Iron and Steel. G. E. F. Lundell, James Irvin Hoffman & H. A. Bright. John Wiley & Sons, Inc., New York, 1931. Cloth, 6 x 9 inches, 641 pages. Price $7.00.

Chemists who have used the excellent treatise "Applied Inorganic Analysis," by Dr. Hillebrand and Dr. Lundell, will welcome this new book. Since it covers a much narrower field than the former book, it gives details of manipulation more minutely. The same meticulous care has been exercised in its preparation and the book is replete with references.

The work is divided into 5 parts. The first, under the title "General Considerations," deals with apparatus and reagents; qualitative tests of steels; separation of iron from accompanying elements; common operations, such as sampling, weighing, choice of method of analysis, solution of the sample, precipitation, filtration, washing, drying and igniting precipitates, and the determination of blanks; special operations, including the removal of ammonium salts and organic matter from solution; volumetric analysis, including an excellent discussion of the use of indicators and a simple though thorough outline of potentiometric titrations; accuracy of determinations; and standard samples. Part 2 (260 pages) considers methods for the determination of the constituents of irons and steels. The elements are divided into 3 groups: (a) Ordinary constituents: Fe, C, Mn, P, S, Si; (b) common alloying constituents: Cu, Ni, Cr, V, Mo, W and Co; and (c) less common constituents: Al, Ti, Zr, Cb and Ta, U and the rare earths, arsenic, tin and antimony, zinc and boron. Usually a chapter, averaging about 13 pages, is devoted to each element. Part 3 deals with methods for the determination of oxygen, oxide inclusions, hydrogen, and nitrogen. Part 4 takes up the analysis of ferro-alloys, and part 5, methods for the analysis of ores, limestones, fluorspar, refractories, slag, molding sand, and coal and coke.

The authors state (page 129): "A distinction should be drawn between accuracy and precision. Briefly, but somewhat roughly stated, accuracy is a measure of degree of correctness; precision is a measure of reproducibility in the hands of a given operator. The precision of a result does not have anything to do with its accuracy. It merely serves as a measure of the duplicability of the procedure in the hands of a given operator." With this as their thesis the authors outline procedures leading not only to reproducible results, but also giving the degree of accuracy demanded for a given type of determination.

The determination of each element is discussed in much the same manner. Under general considerations, the method by which the element finds its way into iron or steel, its effect, and the usual amounts found in various kinds of iron and steel are discussed. Methods of decomposition, separation and determination are taken up in order. Routine and empiric determinations are considered. Precautions to follow and the effect of interfering elements are outlined. In many instances more than one method of analysis is described.

At the end of each chapter, a table gives the accuracy of determinations of the element. This includes the Bureau of Standards sample number, material (i.e. Bessemer 0.1 carbon steel, A.O.H. 0.6 carbon steel, etc.), probable value, extreme results, average deviation from probable value, results outside of average deviation of all results, number of results reported, number reported high and number reported low.

Chemists usually search in vain in books on the analysis of iron and steel for the determination of small quantities of such contaminating elements as Cr, Mo, and V found in plain carbon steels. In this book the authors describe special colorimetric methods for such determinations.

There are remarkably few typographical errors or omissions, although on page 384, in discussing the analysis of tin, one is instructed to "add a solution of about 10 or 20 ml. of antimony chloride of sulphate.

The book appears to have been prepared with great care. Accuracy such as has been attained at the Bureau of Standards can be secured only by strict adherence to the minutest details of manipulation and procedure. The authors have furnished an invaluable tool to analytical chemists. J. D. Sullivan. (14)-B-

HISTORICAL & BIOGRAPHICAL (15)

The Advances of Steel Making in Electric Furnaces (Le développement mondial de la production d'acier au four électrique). *Journal du Four Electrique,* Vol. 40, Dec. 1931, pages 470-471.

A short summary of the development of electric furnace steel making in the world from its conception to the present time. JDG (15)

Pig Iron in Canada. George A. Simpson. *Canadian Foundryman,* Vol. 22, Oct. 1931, page 19.

A very brief résumé of the history of the pig iron industry in Canada from 1800 to 1853. OWE (15)

Permanent International Commission for Acetylene Autogenous Metal Working and Affiliated Industries. (Ständige Internationale Commission für Azetylen, autogene Metallbearbeitung und verwandte Industrieen.) *Die Schmelzschweissung,* Vol. 11, Jan. 1932, pages 12-13.

The history of the commission, countries participating, meetings held are reviewed. World consumption of calcium carbide, oxygen and liquid acetylene is tabulated. Ha (15)

Founding Throughout the Ages. *Foundry Trade Journal,* Vol. 45, Oct. 15, 1931, page 244.

Report of an address on the above subject by G. C. Castle. Reference is made to some of the more outstanding examples of the foundryman's art, which have been brought to light by archaeologists and of which information is at hand today. OWE (15)

Incredible Carnegie. J. K. Winkler. Vanguard Press, New York, 1931. Cloth, 6 x 9½ inches, 307 pages. Price $3.50.

This account of Carnegie's career is written in the modern biographical style, featuring the shortcomings of the man described. Carnegie is characterized as cold-blooded, making his fortune by using men ruthlessly. He was not interested in technical details; his forte was in choosing and handling men. Up to the time he sold out at 66, he is shown as a hard and ruthless man. The remainder of his life was devoted to philanthropic work, but, according to Winkler, his philanthropy was rooted in a desire for adulation rather than in a sincere desire to help mankind. A twelfth of the income of the U. S. Steel Corporation is still said to be "clutched from the grave" by Carnegie for the support of his various foundations.

The biography may show all facets of Carnegie's nature in their proper light, but one wonders if, after all, a truly fair biographer would not have found something in his character to admire. A man who spent his last day of health bass-fishing might have been dealt with more generously. Winkler writes with the assumption of impartiality but does not convince the reader that he is impartial. The book seems to be written by a biographer rather than an historian.

The book is about Carnegie, not about the steel industry, but side comments on the revolutionary advances in technology and production methods made by his associates will interest the metallurgist. H. W. Gillett (15)-B-

The Black Country and Cold Blast Pig Iron. *Iron & Steel Industry & British Foundryman,* Vol. 5, Dec. 1931, pages 80-82.

A short history of the development of the industry in the Black Country, South Staffordshire. This iron has the property of throwing a chill with absolute certainty. The lower the Si and the higher the S, the deeper the chill, as a rule. CHL (15)

Activities of the Verein deutscher Eisenhüttenleute for Year 1931. (Ueber die Tätigkeit des Vereins deutscher Eisenhüttenleute im Jahre 1931.) *Stahl und Eisen,* Vol. 52, Jan. 21, 1932, pages 53-68.

Number of papers published on various subjects given for 1931 and total since year 1840. Important papers and work of committees are discussed with relation to industry, such as Siemens-Martin and Thomas Steel processes, electrolytic steel, rolling mill, coke and gas plant, annealing, heat treatment, etc., and also work done jointly with other organizations. DTR (15)

A Review of Water Works Progress. Caleb Mills Saville. *Water Works Engineering,* Vol. 85, Jan. 27, 1932, pages 85-88.

The development of water works engineering as a science during the past half century period. Introduction of various features such as cast iron pipe, new types of pumping machinery, wrought iron, steel, and concrete pipe, meters, etc., are touched upon from a historical as well as scientific standpoint. CBJ (15)

Wrecking Home Insurance Building Reveals Excellence of Old Metals. Henry Penn. *Engineering News-Record,* Vol. 108, Feb. 18, 1932, pages 247-248.

Building dismantled in Chicago was built of cast Fe, wrought Fe and the first steel beams used in a building in this country. Chemical analyses, photomicrographs, and physical tests of the metals used are included. CBJ (15)

Development of the German Steel Industry in the Last 50 Years. (Entwicklungslinien des deutschen Eisenhüttenwesens in den letzten 50 Jahren.) O. Petersen. *Stahl und Eisen,* Vol. 52, Jan. 7, 1932, pages 1-13.

Paper before the 123rd Annual Meeting of the Verein deutscher Eisenhüttenleute, Nov. 29, 1931, Düsseldorf. A most interesting, detailed and illustrated description of the progress of the German steel industry in the last 50 years. GN (15)

The Reduction of the Corrosion Tendency of Steel. (Die Verminderung der Korrosionsfähigkeit des Stahls.) Sedlaczek. *Korrosion,* Beilage zur *Chemischen Apparatur,* Vol. 6, Nov. 25, 1931, pages 49-50.

A historical compilation of patents on the production of rustless or corrosion proof steels. The earliest example is a suggestion by Berthier in 1821 who recommended an addition of Cr. Ha (15)

Rails 1831-1931, A Century of Development. T. J. Stillman (Penna. R. R.) *Metal Progress,* Vol. 20, Nov. 1931, pages 37-42.

The author recounts the development of the all metal rail of T-shape from 1831 to the present. The change from iron to steel and from a weight of 36 lb./yard to 152 lb./yard; these latter rails are now the standard on the heavy traffic sections of the Pennsylvania Railroad. Specifications and steel quality are reviewed. WLC (15)

ECONOMIC (16)

The Non-Ferrous Metals in 1931. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 30, 32.

An article in which special attention is directed to the world market for copper during 1931. OWE (16)

The Demand for Cast Iron—Past and Present. *Foundry Trade Journal,* Vol. 45, Oct. 8, 1931, page 224.

Reviews the manner in which competition has lessened the market for iron foundry products. He emphasizes the value of national advertising schemes in promoting interest in various materials and shows by reference to a number of different products, which can be made in cast iron, what might be looked for in the way of new business if efforts were made to obtain it in the manner described above. OWE (16)

The Foundry Equipment Industry in 1931. D. Howard Wood. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, page 36.

A brief statement of changes which have occurred in 1931 in the equipment of foundries in Great Britain. Some reference is made to mechanization which has taken place in certain foundries in the U. S. A. and to the fact that some of these improvements have been adopted in Europe. OWE (16)

Engineering Achievements of Industry Rank High in Depressed 1930. E. F. Ross. *Steel,* Vol. 88, Jan. 1, 1931, pages 279, 290.

Although a period of greatly restricted production, the year 1930 witnessed considerable engineering and technical progress, with many improvements in production methods and a noteworthy expansion in research and scientific work. JN (16)

Reduction of Costs and Improved Quality by New Shop Methods of Measurement. (Kostensenkung und Gütesteigerung durch neuzeitliche Werkstattmessverfahren.) O. Schlippe. *Maschinenbau,* Vol. 10, Feb. 19, 1931, pages 134-139.

The demand for change is being forced to standardization. Systematic building up of the whole method of measurement is being attempted by workmen and technical societies. This standardization is indicated in the literature in several places. The development of measuring methods and the tests of the methods, have led to increased accuracy in testing and to improvements in apparatus. Several examples are cited. MAB (16)

The Effect of Business Demands on the Economy of Power and Materials in Plant Operations. (Der Einfluss des Beschäftigungsgrades auf die Energie-und Stoffwirtschaft der Hüttenwerksbetriebe.) Berthold von Sothen (Düsseldorf). *Stahl und Eisen,* Vol. 52, Jan. 14, 1932, pages 29-38; Jan. 21, 1932, pages 68-70.

Includes 16 references, 5 tables, and 18 diagrams. With mill demands cut from 30 to 40%, study of production methods was made in modern blast furnace—mill—steel—gas—coke plants from angle of cost, in order to arrive at most economical number of working days per week. Heat and power requirements and efficiency of furnaces and machines are emphasized. Daily costs of producing gas from coke in the intermittent and continuous producers are given. The trend is towards use of cheaper coals, such as Saar peat and smudge, and intermittent use of outside gas and electricity. GN + DTR (16)

Electrified Trackage Becoming more Concentrated. *Transit Journal,* Vol. 76, Jan. 1932, pages 19-21.

Total trackage operated has decreased 14.9% since 1923. Abandonments have been confined to small cities and communities. CBJ (16)

World's Production and Consumption of Lead in 1930. (Produccion Y Consumo De Plomo En El Mundo En 1930.) *Revista Minera,* No. 3288, Nov. 1931, pages 517-18.

Reprinted from *Metallgesellschaft,* 1931. In thousands of metric tons, world production for 1920, 1925 to 1930 inclusive: 859, 1,485, 1,565, 1,638, 1,598, 1,662, 1,560, respectively. Total consumption: 975, 1,497, 1,560, 1,602, 1,640, 1,689, 1,505. DTR (16)

World's Production and Consumption of Zinc. (Produccion Y Consumo De Zinc En El Mundo.) *Revista Minera,* No. 3291, Dec. 1931, pages 557-58.

World's consumption 1920, 1925 to 1930 inclusive, in thousands of tons: 688, 1,176, 1,228, 1,308, 1,412, 1,435, 1,223, respectively. Production for same years: 735, 1,166, 1,380, 1,392, 1,379, 1,499, 1,312. DTR (16)

International Tin Research. *Tin,* Dec. 1931, pages 1-2.

The British Tin Producers have subscribed a sum of £28,000 a year for research and development work in expanding the existing market for Sn, to find new markets, and to preserve and strengthen those markets where Sn meets with rivals. A particular problem to be treated is Sn plate. Ha (16)

The Need of a Copper Tariff. A. E. Petermann. *Mining and Metallurgical Society of America, Bulletin* No. 222, Vol. 24, Dec. 1931, pages 84-94.

The need of a tariff on Cu is discussed from the points of view of national economy and national defense. Ha (16)

Copper Tariff. Arthur Notmann. *Mining and Metallurgical Society of America, Bulletin* No. 222, Vol. 24, Dec. 1931, pages 102-115.

The pros and cons of a high tariff are weighed against one another; it is concluded no tariff is necessary. We could buy up for the navy and army, all cheaply offered Cu in the market for a war stock. Ha (16)

The Foundry Industry in Czecho-Slovakia in the Year 1931. Frant. Pisek. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, page 26.

A brief description of the production, employment, and equipment figures for the foundry industry in Czecho-Slovakia during 1931. OWE (16)

Investigation of the Economy of a Rolling Schedule (Untersuchung der Wirtschaftlichkeit eines Walzprogramms). V. Polak. *Stahl und Eisen,* Vol. 51, Dec. 24, 1931, pages 1593-1594.

The author advises that means for calculating the costs of rolling of various shapes to be rolled by a mill be devised. GN (16)

PLANTS & LABORATORIES (17)

The "Trinec" Continuous Bar and Sheet Billet Rolling Mill. *Demag News,* Vol. 5C, Nov. 1931, pages C33-C41.

The new plant of the Berg und Huettenwerks-Gesellschaft Trinec, Czechoslovakia, is designed to roll blooms of maximum 4.5 tons, 10 in.^{2}, into sheet bars $1\frac{1}{16}$ to $1\frac{3}{8}$ in. thick and 12, 10 or 8 in. wide, and billets and sheet bars. The output is 125 tons of sheet bars per hour. Two continuous trains are installed, billet and sheet rolling schedules are diagrammatically illustrated and the whole plant with auxiliary equipment described. Ha (17)

London Headquarters of British Non-Ferrous Metals Research Association. *Engineering,* Vol. 131, June 12, 1931, pages 772-773.

An interesting description of the building housing the laboratories of the British Non-Ferrous Metals Research Association. LFM (17)

New Edmonton Foundry Opened by Standard Iron Works. *Canadian Foundryman,* Vol. 22, Nov. 1931, page 13.

Brief description of a new foundry opened in Edmonton, Alta., by the Standard Iron Works, Limited. OWE (17)

The Laboratories of the German Aluminum Producing Industries. (Die Laboratorien der deutschen Aluminium herstellenden Industrien.) H. ROEHRIG. *Aluminium Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Sept./Nov. 1931, pages 357-361.

Descriptions and illustrations of the equipment of the various plants. Ha (17)

The Wire Mill of the Roechling Iron & Steel Works in Voelklingen. (Die Drahtstrasse der Roechlingschen Eisen- und Stahlwerke in Völklingen.) F. HILGENSTOCK. *Stahl und Eisen,* Vol. 51, Aug. 13, 1931, pages 1026-1028.

The enlarged plant for drawing 100 mm. square billets into wires and the schedule of the mill with 6 stands is described; the capacity is 1?3 tons/shift. The consumption of grease for drawing operat.ons is 60 g./ton or 0.7¢/t. Ha (17)

A New German Testing Laboratory. R. W. MILLER. *Heat Treating & Forging,* Vol. 17, July 1931, pages 665-667.

The equipment of the physical testing laboratory of Sulzer Bros. is described. Machines for notched-bar tests, welded joints, pendulum impact tests, bending tests and metallographic examinations are briefly described. Ha (17)

Research in the Nickel Industry. P. D. MERICA. *Inco.* Vol. 11, No. 1, 1931, pages 14-16.

Description of the equipment of and scope of the research done in the laboratories of the International Nickel Company. Ha (17)

Production Economy in Iron and Steel Works. Part I. OTTO CROMBERG. *Engineering,* Vol. 131; May 15, 1931, page 650.

Abstract of a paper read before the Iron and Steel Institute, London, May 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 276. LFM (17)

Individual Roll Motors—Photo-Electric Cells—Tools of a Modern Steel Mill. RALPH H. WRIGHT. *Electric Journal,* Vol. 28, July 1931, pages 403-407.

An illustrated description of a mill in which electric requirements have been introduced to the utmost degree. WHB (17)

Modern Heat Treating Equipment Cuts Cost to One-Third for Cleveland Tractor Co. JOSEPH GESCHELIN. *Automotive Industries,* Vol. 65, July 1931, pages 46-47.

Description of Cleveland Tractor Company modernized plant. 2 pusher type furnaces both gas and electrically fired, special gas carburizing horizontal retort furnaces are shown in detail. DTR (17)

The Foundries of Messrs. Alfred Herbert, Limited. *Foundry Trade Journal,* Vol. 45, July 16, 1931, pages 40-42.

An article accompanied by 8 photographs and 1 diagram showing the general layout of the foundries referred to above. Details are given of the equipment of these foundries, which are designed for the production of castings to be used in the manufacture of machine tools. OWE (17)

The Acton Precious Metals Refining. *Canadian Mining Journal,* Vol. 52, May 15, 1931, pages 509-510; *Brass World,* Vol. 27, June 1931, pages 133-134; *Industrial Chemist,* Vol. 7, May 1931, pages 207-208; *Metal Industry,* London, Vol. 38, Apr. 24, 1931, pages 425-428.

The metallurgical equipment of this plant is described. Smelting and cupellation are carried out in small basic lined tilting furnaces of novel design, charges being poured from these oil-fired furnaces. The scrubbing plant recovers more than enough precious metals to pay for its operation. The equipment for the wet process buildings is compactly arranged on a series of terraces of acid-proof construction. The Clydach concentrate containing a relatively large proportion of Ag and Pb receives an initial smelting operation —the Pb absorbing the precious metals. Cupellation removes most of the Pb. Parting is effected with sulphuric acid. Subsequent treatment with aqua regia removes Pb, Pd, and Au. Pt is precipitated as ammonium platino chloride and Pd as palladosammine chloride. Ag and Au are purified by electrolysis. Ru, and Ir in the final insolubles and reduction residues are remelted to concentrate them and the alloy obtained is returned for wet treatment. WHB&RAW&PRK (17)

Cast Iron Pipe Competing with Steel. *Metal Progress,* Vol. 19, Apr. 1931, pages 71-74.

Describes the plant and methods for making cast iron pipe by the American Radiator Company. WLC (17)

Annealing Plant of Franz Seiffert & Company, Eberswalde, Germany (Glüheinrichtung bei der Firma Franz Seiffert & Co.) *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Jan. 24, 1931, pages 112-113.

The very high steam pressures used at present in power plants require pipes of highest quality. All cold working of the material to be used in such pipe lines must be avoided in manufacturing it, since aging phenomena which have a harmful influence on the material and reduce the operating safety are produced by cold working. Careful treatment in annealing subsequent to working is necessary. The furnaces of this company are briefly described. Ha. (17)

MACHINERY & SUPPLIES (18)

The Design and Application of Cranes to Steel Mill Service. Part II. G. W. YANNEY (The Alliance Machine Co.). *Rolling Mill Journal,* Vol. 5, Mar. 1931, pages 201-204.

Safety features on the all-electrically operated crane of today include steel footwalks around girders and beams, platforms under bridge girders and trolleys, gears completely enclosed or guarded, guarded shaft couplings, forward track wheels equipped with fenders, rope sheaves and shafts completely covered, automatic limit stop for crane hook, and safety compartment in operator's cab. Within the last 5 years, there has been a change from cast iron to cast steel as a material of construction, resulting in added safety, extended life, reduced weight, and reduced power consumption. All parts subject to repair or renewal are made readily accessible by means of walkways and platforms. Points of lubrication are easily reached. The modern crane designer strives for simplicity of design, the avoidance of a multiplicity of different parts, compactness within the bounds of accessibility, and an attractive general appearance. JN (18)

Pig Bed Crane with Separate Grabs for Pig Breaking and Loading. *Demag News,* Vol. 5C, Nov. 1931, pages C45-C47.

Describes the construction. Ha (18)

Feeder Trucks for Blast Furnace Charging Plants. *Demag News,* Vol. 5C, Nov. 1931, pages C42-C45.

The mechanical construction and operation is described. Ha (18)

Modern Stretching Machines. (Neuzeitliche Spann-und Streckmaschinen.) H. KREBS. *Stahl und Eisen,* Vol. 51, Feb. 19, 1931, pages 232-234.

The continually increasing demand for steel sheets has brought with it a demand for improved quality, in respect to physical and mechanical properties, homogeneity, uniformity of thickness, and surface. This has led to the development of new types of apparatus, for stretching and straightening sheets, and at the same time avoiding uneven straining of them. Such a machine fitted with strain control and stress distribution devices and other tensile testing machines for testing bars and strips with perfectly uniform distribution of the stress is illustrated. Ha (18)

The Degree of Rigidity of Tool Machines. (Der Starrheitsgrad von Werkzeugmaschinen.) CARL KRUG. *Maschinenbau,* Vol. 10, Aug. 6, 1931, pages 505-506.

This is an article which follows up the line of thought presented in a paper by Dr.-Ing. Reichel on the same subject, published in *Maschinenbau,* Vol. 10, Apr. 16, 1931. It presents a method of evaluating tool machines, which should be of value to German tool machine manufacturers. MAB (18)

Design and Construction of Turbo-Blowers for Steel Mills (Entwurf und Ausführung von Turbogebläsen für Hüttenwerker). M. SCHATTSCHNEIDER. *Stahl und Eisen,* Vol. 51, Nov. 5, 1931, pages 1361-1370.

Report of the Committee on Machinery of the Verein deutscher Eisenhüttenleute. The article deals with the general principles which must be borne in mind in designing turbo-blowers to meet the requirements for obtaining a high efficiency. These conditfons are illustrated in diagrams. The devices of air outlet and diffuser regulation are described and data are given on aspirated volume, air pressure, number of revolutions. The general layout of turboblower plants for a 300 ton and a 1000 ton blast furnace are diagramatically shown. Some sketches show new designs of blowers as they have been installed at the Huckingen plant of the Mannesmann Tube Works and at the Friedrich Alfred plant of the Krupp Works. The paper concludes with some information on turbo-blowers for Bessemer plants which have been built by the Brown, Boveri Company. GN (18)

Iron and Steel Plant Pumping Equipment. JOHN H. JONES. *Rolling Mill Journal,* Vol. 5, Nov. 1931, pages 727-730.

Types of pumps and factors for their efficient operation are explained. Ha (18)

Recent Developments at the International Foundry Exposition at Milan. (Neuerungen auf der Mailänder Internationalen Giesserei-Fachausstellung.) TH. GEILENKIRCHEN. *Die Giesserei,* Vol. 18, Dec. 11, 1931, pages 931-934; Dec. 25, 1931, pages 948-953.

Several new constructions, especially of Italian machinery, of recent development are described in the fields of transport equipment, molding machines, molding sand preparing machines, shaking-presses and auxiliary equipment in the foundry. Ha (18)

The Driving of Mill Table Rollers. WM. ALBRECHT. *Rolling Mill Journal,* Vol. 5, Sept. 1931, pages 611-614.

The advantages of the individual drive of mill table rollers are explained and the different types of motor-driven rollers developed for this purpose described. Ha (18)

Device for the Transportation of Billets from One Roller Bed to Another (Vorrichtung zum Befördern von Knüppeln von einem Rollgang zum anderen). P. TERPE. *Stahl und Eisen,* Vol. 51, Nov. 19, 1931, pages 1437-1438.

Description of a simple ingenious device to swing billets weighing about 400 lbs. from the runout of the billet mill over to the rolling bed of a rod mill rectangular to the billet mill. The manual labor of 2 men could thus be saved. GN (18)

Blast Furnace Blowing Engines. The Relative Merits of the Gas Engine and the Turbo-Blower. F. JOHNSTONE TAYLOR. *Iron & Steel Industry & British Foundryman,* Vol. 5, Dec. 1931, pages 109-114.

A summarization of both sides of the case. CHL (18)

Metal Baths for Carrying Heat to Cooking, Distillation and Similar Apparatus. (Metallbad zur Wärmeübertragung für Koch-, Destillier-und ähnliche Apparate.) TH. MELZ. *Apparatebau,* Vol. 43, Apr. 2, 1931, pages 76-77.

A short description of the construction of a few metal heating baths. Ha (18)

MISCELLANEOUS (20)

Use of the Correct Lubricant and Proper Protection for Bearings in Stock will Go Far toward Preventing Anti-Friction Bearing Troubles. Elmer Zitzewitz (Aetna Ball Bearing Manufacturing Co.). *Blast Furnace & Steel Plant,* Vol. 19, Nov. 1931, pages 1471-1472.

All bearings not in use and before installations should be kept in sealed wrappings so as to protect against dirt, moisture and the atmosphere, after coating them generously with a rust preventive. Oil is preferable as a lubricant for high speeds and grease for low speeds. Only a pure mineral oil or grease should be used. Loss of lubricant because of leakage and vaporization can be obviated by sealing the bearing. To eliminate most of the troubles now being experienced with anti-friction bearings, it is important to choose the proper size and type of bearing, mount it properly, lubricate it properly and maintain it properly. MS (20)

Overhead Handling in a Stamping Plant. Thorpe E. Wright. *Metal Stampings,* Vol. 4, Aug. 1931, pages 641-643.

The importance of transportation costs of the parts moved from place to place in stamping plants with regard to overhead costs is noted. Their possible reduction is illustrated by an example of a factory for automobile head lamps. Ha (20)

The Metallurgist in the Foundry. F. S. Wordsworth. *Foundry Trade Journal,* Vol. 45, Oct. 22, 1931, page 253-254.

A discussion of the status and duties of the metallurgist in the foundry and the improvement that comes through a scientific viewpoint of foundry problems. Reference is made to the valuable work which has been done by the British Cast Iron Research Association in assisting British foundrymen, and attention is directed to the need of financing further research work in foundry practice. OWE (20)

Lead Solution Used to Recover Tin from Scrap. A. E. Buchanan. *Scientific American,* Vol. 146, Feb. 1932, page 107.

A new method for reclaiming the tin plate from old tin cans has been developed. The tin plate is treated with a solution of 4.45% lead, 10.25% caustic soda and 85.3% water. At a temperature of 90° C., the tin is removed by this solution from the tin plate in a few secs. and, until the lead in the solution is nearly all displaced, the rate of attach is high. In the reaction, for every 2 atoms of tin dissolved, 3 atoms of lead are deposited. Because of the deposition of finely divided lead, it is necessary to agitate the tin plate to ensure its removal from the surface of the material. Revolving drums are so used that the process is continuous. The sodium stannate solution obtained is treated with caustic lime, by which a precipitate of calcium stannate is obtained and the caustic soda solution regenerated for use. The precipitated lead is placed in a tower with the regenerated caustic soda and air is blown through. After 20 hrs., the original treating solution is obtained by hydration of the lead and its solution in the liquid. WAT (20)

The Reactions of Active Nitrogen with Hydrogen Atoms at Metallic Surfaces (Ueber die Reaktion von aktivem Stickstoff mit Wasserstoffatomen an metallischen Oberflächen). J. K. Dixon & W. Steiner (University of Berlin). *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 14, Nov. 1931, pages 407-412.

The formation of ammonia from atoms of N and H at the surfaces of Cu, Fe, Ni and Zn was investigated. The course of the reaction and its dependence on the H-atom concentration is in accordance with the authors' assumptions, previously published (see *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 817-830) that the formation of NH_3 takes place over NH as an intermediary product in 3 phases. EF (20)

Flexibility of Plain and Creased Pipe Bends. A. M. Houser & S. Hirschberg. *Power,* Vol. 74, Oct. 20, 1931, pages 568-571.

A discussion. AHE (20)

Lubrication of Steel Mill Motors. J. L. Brown. *Rolling Mill Journal,* Vol. 5, Sept. 1931, pages 607-610, 614-615.

Different principles and systems of lubrication of electric motors are described. Ha (20)

Processes for the Preparation of Pure Carbides, Nitrides and Borides of High Melting Points and Description of some of their Properties. (Methoden zur Reindarstellung hochschmelzender Karbide, Nitride und Boride und Beschreibung einiger ihrer Eigenschaften.) C. Agte & K. Moers. *Zeitschrift anorganische und allgemeine Chemie,* Vol. 198, June 10, 1931, pages 233-275.

A few methods for the production of pure carbides, nitrides and borides are described; the purification is effected by annealing at highest temperatures. The following materials were prepared, which represent the highest melting points:

Zirconium—carbide	Zr C	Melting point	3805° C.
Hafnium—carbide	Hf C	"	4160° C.
Zirconium—nitride	Zr N	"	3255° C.
Tantalum—nitride	Ta N	"	3360° C.
Zirconium—boride		"	?265° C.
Hafnium—boride		"	3335° C.

The melting point curves of the two systems titanium carbide—titanium nitride and tantalum nitride—tantalum carbide were determined; a maximum melting point could be stated at a composition of equal mols of Ti N and Ti C. Tables of electrical conductivity with temperature coefficients are reproduced. Ha (20)

Residual Strains in Materials used in Machine Construction. (Zulässige Spannungen der im Maschinenbau verwendeten Werkstoffe.) Ernst Bock. *Maschinenbau,* Vol. 10, Feb. 5, 1931, pages 68-83.

Reviews various papers by Dr.-Ing. Bock covering the following subjects: Formation of the guide lines for structures; strength of the materials; factors of safety; scientific influences; deformation; the state of strain; recognition of fracture; reliability of tables giving "residual" strains; curves indicating the limit of strain; method to be taken as a model for construction of machine parts. MAB (20)

LABORATORY APPARATUS (21)

Electrical Resistivity of Certain Copper Alloys in the Molten State. C. S. Williams (Westinghouse Research Laboratories). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 240-241.

The author describes apparatus for the determination of the electrical resistance of molten alloys. The use of the induction furnace for the melting of alloys has made such information of use in the design of furnaces for this work. WLC (21)

Vibration-proof Mounting by Means of Air Cushions. (Eine erschütterungsfreie Aufstellung mittels Luftpolsters.) E. Gehrke & B. Voigt. *Zeitschrift für technische Physik,* Vol. 12, Dec. 1931, pages 684-686.

The generally known mounting method according to Julius as well as the mounting device of Müller-Leybold satisfactorily eliminates the horizontal component of the vibration disturbances whereas the vertical components are still occurring. A new method of shock-proof mounting is shown which overcomes both kinds of difficulties so that complete absence of vibrations is secured. The following elements are embodied in the vibration-proof mountings: tennis balls, rubber air cushions, elastic steel rods, damping tanks filled with paraffin oil and containing several metal sheets ("Schlingertank"), and finally a large box to get rid of air current. Three different manners of shock-proof mounting are fully discussed in this paper which was presented at the 7th Deutscher Physiker & Mathematikertag, Bad Elster, Sept. 13-18, 1931. EF (21)

Micro-stereograms and their photographic Evaluation. (Mikro-stereoaufnahmen und deren photogrammetrische Auswertung.) R. Lorenz. (Technische Hochschule Dresden). *Der Papier-Fabrikant,* Vol. 28, Nov. 30, 1930, pages 805-809.

A unique utilization of the Aerokartograph of Hugershoff for stereo measurements is demonstrated by the evaluation of a microscopic sample, and the interest of the metallurgist is attracted by the suggestion of adopting this kind of measurement for the quantitative evaluation of corrosion pits, for the testing of surface smoothness and for crystal measurements. EF (21)

Use of Chrome Steel Articles for Analytical Purposes. (Über die Verwendbarkeit von Chromstahlgefässen zu analytischen Zwecken.) Albert Krüger. *Chemiker Zeitung,* Vol. 55, Sept. 5, 1931, pages 682-683.

Contains 2 references. Casseroles made of V4A steel can be used for NH_4OH and dilute NaOH solutions. They are better suited than glass or porcelain for handling the hydroxides of Fe, Al, Cr, Cu and Ni and $ZnCO_3$. They are also suitable for H_2O_2, Na_2S and Fehling solutions. In Fe and Al determinations made in chrome steel casseroles, no SiO_2 is found in the precipitate. The amount of steel dissolved after boiling solutions of NaOH, KOH, K_2CO_3, $Ba(OH)_2$, Na_2S, KOH + Na_2S, KOH + H_2O_2 was found to be less than the amount of SiO_2 dissolved from glass vessels. CEM (21)

Laboratory Shaking Machine. Nathaniel Herz. *Engineering & Mining Journal,* Vol. 133, Jan. 1932, page 22.

A 32-compartment shaking machine is described and illustrated. It is employed for amalgamation tests and for nearly all cyanide work. WHB (21)

Limits of Microscopy. Beginning of the Molecular Optics (Grenzen der Mikroskopie. Beginn der Molekularoptik). F. Jentsch. *Zeitschrift für Instrumentenkunde,* Vol. 51, Aug. 1931, pages 441-442.

Author aims at the development of an X-ray microscope with the object of extending the present measuring range from 0.2μ to 0.02 μ. EF (21)

Novelties in the Design of Micro-Photographic Apparatus (Ueber neue Wege im Bau von mikrophotographischen Apparaten). F. Hauser. *Zeitschrift für Instrumentenkunde,* Vol. 51, Sept. 1931, pages 483-488.

Refers to microscopes built by the E. Busch Co., Rathenow, Germany, and notes in detail recent developments. (21)

Gauge Checking Laboratory at Stanford University. M. S. Hugo. *Western Machinery World,* Vol. 22, Dec. 1931, pages 535-537.

A description of the building and modern equipment of the gauge checking laboratory at Stanford University under the Ordnance Department of the U. S. Army is presented. The University proposes to maintain an unbiased position by refusing to allow the personnel of the gage laboratory to engage in private consulting work. Charges for gage checking are nominal, just sufficient to cover laboratory costs. (21)

Modern Methods of Metallurgical Testing (Les Méthods moderne d'essais en Métallurgie). M. Favollet. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, May 1931, pages 220-236; Vol. 6, June 1931, pages 272-292.

In a series of 3 lectures, the author makes a detailed review of all the testing methods, equipment and apparatus used in metallurgical laboratory for control and research. (21)

A Vacuum Technic for the Chemist. K. Hickman. *Journal of the Franklin Institute,* Vol. 213, Feb. 1932, pages 119-154.

Communication No. 489 from Kodak Research Laboratories and presented at meeting of Franklin Institute Feb. 18, 1931. Includes bibliography of 18 references, and 19 diagrams. A manipulation chart for vacuum assemblies for variety of purposes is shown, each set forming an independent unit capable of performing a specific operation. Work of assembly requires nothing more than sealing of 2 or 3 joints. Combinations of apparatus are by no means exhaustive. Phthalate condensation pumps may be coupled to vacuum spectographs and X-ray tubes. Vacuum oven technic may be employed for cathodic spluttering of metals, study of shrinkage of fibers and cellulosic sheets on prolonged desiccation, regeneration of materials like silica gel or animal charcoal. DTR (21)

On the Polarization Capacity of Mercury Electrodes (Ueber die Polarisationskapazität von Quecksilberelektroden). T. Erdey-Gruz & G. G. Kromey (Technische Hochschule, Berlin). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 157, Nov. 1931, pages 213-214.

An electron tube relay is described which in connection with an oscillograph is fitted for taking voltage/time curves under conditions characterized by the nearly complete absence of currents. EF (21)

A New Method for the Inexpensive Manufacture of Reversible Pattern Plates (Neues Verfahren zur billigen Herstellung von Reversiermodellplatten). F. Brobeck. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 13, 1931, pages 879-887.
Description of a method by which a reversible pattern can be made from a single-sided pattern so that molds can be better utilized, even though only a small quantity are to be made. This method is also suitable for machine molding. Some remarks are made on the estimating of costs of manual and machine molding. Ha (22)

Deep Etching of Brass Applied to Gating Problems. R. W. Parsons. *Metal Industry,* London, Vol. 39, Aug. 21, 1931, pages 177-179; *Metal Industry,* New York, Vol. 29, Nov. 1931, pages 477-480.
From paper given at American Foundrymen's Association, Chicago. Illustrations are given showing that the deep etch test can be useful with problems of gating which have to do with the production of sound castings. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. PRK (22)

Electric Brass Furnace Saves Its Cost in Two Years. *Electrical World,* Vol. 99, Jan. 30, 1932, pages 234-235.
An analysis of comparative production costs by the Rockwood Sprinkler Co., Worcester, Mass., for coke-fired and electric equipment shows that the electric furnace paid for itself in 2 years. The furnace employed was of the indirect-arc rotary type made by the Detroit Electric Furnace Co. Operating figures are given. Economy of production, close temperature control and elimination of gas and foreign particles from the melt, feature their operation. WHB (22)

Brackelsberg Process Produces Grey Iron of Higher Quality. *Canadian Foundryman,* Vol. 22, Oct. 1931, pages 7-10.
A very complete description of results obtained during the use of the 2-ton Brackelsberg furnace, accompanied by 3 photographs and 4 tables. OWE (22)

Modern Notions for Jobbing Foundries. A. S. Worcester. *Foundry Trade Journal,* Vol. 45, Oct. 29, 1931, page 276.
In his presidential address to the West Riding of Yorkshire Branch of the Institute of British Foundrymen, the author discusses the desirability of disseminating technical data to the small foundrymen, the desirability of mechanization, the baneful influence of bad costing, and the necessity of improving the personnel of foundries. OWE (22)

High-Strength Sand-Casting Aluminum Alloys. W. C. Devereux. *Foundry Trade Journal,* Vol. 45, Nov. 26, 1931, pages 331-335; Dec. 3, 1931, pages 349-352.
A discussion of the "Y" alloy, the R.R.50 and R.R.53 alloys, and the 4% Cu-Al alloy. Discusses the difficulties which meet the foundryman, owing to competition of drop forgings of these alloys with castings. Deals with the mechanical properties of the light alloys, with the question of the solidification and its relation to the soundness of these alloys, and with their wear and friction characteristics. These points are illustrated by a number of diagrams. Casting properties of these alloys are discussed. Special attention is paid to the necessity for close temperature control of melting and pouring, and to other practical details of the molding of these alloys. The paper is accompanied by 21 diagrams and photographs and 8 tables. OWE (22)

Recent Developments in the Non-Ferrous Foundry Industry. H. C. Dews. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 40-42.
The author discusses briefly the work of the British technical societies and of the British Non-Ferrous Metals Research Association. He also discusses the work which has been done on impurities in copper and on spectrographic analysis. The growing importance of Si is dealt with in some detail. Reference is made to the results of work that has been carried out on the corrosion of brass condenser tubes and to the fact that 30% Cu-Ni tubes have proved an unqualified success. Attention is directed to another alloy, Al brass, which is finding use in this service. A brief note as to the importance of Be is appended and some attention is given to foundry developments, particularly to the use of the high-frequency furnace and centrifugal casting machines. OWE (22)

The Laboratory and the Foundry. R. Arzens. *Engineering,* Vol. 132, July 3, 1931, page 10.
Abstract of a paper read before the Institute of British Foundrymen, June 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 279. LFM (22)

The Casting of Pistons for Internal Combustion Engines. R. Fischer. *Foundry Trade Journal,* Vol. 45, Dec. 31, 1931, page 409.
Complete translation of article published in *Die Giesserei.* The article is accompanied by 11 diagrams. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 319. OWE (22)

Moulding Practice for Heat-Treated Aluminium-Alloy Castings. Lewis H. Fawcett. *Foundry Trade Journal,* Vol. 45, Oct. 15, 1931, pages 241-242.
Extended abstract of paper read before the American Foundrymen's Association. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 320. OWE (22)

Cutting Production Costs in the Brass Foundry. James Breakey. *Canadian Foundryman,* Vol. 22, Dec. 1931, pages 7-9, 20.
An article, accompanied by 7 photographs, in which a description is given of the methods used in the Empire Brass Manufacturing Company's plant in the production of cores for their castings. OWE (22)

Pattern Storage—a Simple, Economic Plan. H. V. Butterfield. *Canadian Foundryman,* Vol. 23, Jan. 1932, pages 3-5, 14.
Description of a method of attacking the problem of the organization of pattern storage, accompanied by diagrams indicating types of records that have proved satisfactory. OWE (22)

The Production of Iron Castings on a Semi-Repetition Basis. S. Carter. *Foundry Trade Journal,* Vol. 45, Oct. 29, 1931, pages 276-277.
A discussion of the methods that may be adopted by foundrymen who receive orders for small castings in quantities which do not justify a large capital expenditure as a preliminary outlay. OWE (22)

The Application of Pulverized Fuel to the Foundry Industry. W. Boon. *Foundry Trade Journal*, Vol. 45, Nov. 5, 1931, pages 287-291.

The author deals with the types of pulverizers available and discusses briefly the advantages and disadvantages of these different types. Space is devoted to consideration of the types and characteristics of coal and particularly the effect of moisture on coal which is to be pulverized. Transportation of coal within the works is dealt with. The application of pulverized fuel firing to annealing ovens, chilled-roll furnaces and rotary melting furnaces, the effects of pulverized fuel upon refractories, and the influence of ash are described. A report of the discussion of this paper appeared in the *Foundry Trade Journal* for Nov. 19, 1931, pages 321-322. OWE (22)

Fabrication of Fly Wheels and Pulleys (La fabrication des volants et des poulies). *Commission Technique de l'Association Technique de Fonderie de Belgique, Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 913-915.

Dry sand moulds are advised. Rather general recommendations are made as to gates, heads and for control of cracking and shrinking. The irons recommended range from 3-3.5% Si and 1-1.3% P for small wheels down to 1.6-1.8% S and 0.3% P for huge fly wheels. HWG (22)

Results of the Work Done by Societies in Foundry Practice. (Ergebnisse der Gemeinschaftsarbeit im Giessereiwesen.) W. Bültmann. *Maschinenbau*, Vol. 10, Feb. 19, 1931, pages 123-125.

A tendency for improved quality and reduction of production costs is evident. The societies' efforts and the general importance of the work is discussed. There is a need for technical and expert advice which presents the problem as to how it is to be obtained. The following variety of subjects are also considered: cast iron and metals, crude and associated materials, production, operation, samples, and labor. MAB (22)

Recent Developments in the Automobile Foundry Industry. Percy Pritchard. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, page 24.

Refers to the fact that the major percentage of automobile cylinder blocks manufactured in Great Britain are now being made in green sand and that the urgent demand of engineers for better wearing properties has led to the introduction of special high-test cast irons, some containing up to 5% Ni. The use of centrifugally cast liners is referred to, and the fact is emphasized that heat-treated cast iron, which is hardened after machining but before the final grinding, is being largely used in this connection. Some attention is directed to Al foundry work and particularly to the die-casting of alloys of Al base. Reference is made in particular to a multiple impression die containing 8 impressions, the die weighing 33,500 lbs., probably the largest yet produced. The remarkable development in the use of Mg castings is referred to; this increase in production probably approximates 400 or 500%. An infinite variety of articles is now being produced in this metal. The prices at which these castings are being sold today make them reasonably competitive with Al castings made from virgin material. OWE (22)

Improving Castings with the Double Forehearth. (Gussveredlung und Doppelkammervorherd.) Carl Rein. *Giesserei-Zeitung*, Vol. 27, Jan. 1, 1930, pages 8-11.

Cast iron melted in a cupola can be improved by a complete deslagging. This is accomplished by allowing the melt to stand awhile, so that the slag particles may rise to the top. Where various mixtures are melted in the same furnace, the double forehearth has the advantage of keeping the individual melts separate. It is heated to a white heat with an oil burner before tapping, so as not to cool the charge. (22)

Correlating Design and Foundry. Alex Taub. *Machine Design*, Vol. 4, Jan. 1932, page 41.

Successful coöperation of designer and founder is exemplified by the method used by the Chevrolet Motor Co. Ha (22)

Low Total-Carbon Cast Irons and Their Service to Foundrymen. W. West. *Foundry Trade Journal*, Vol. 45, Oct. 29, 1931, pages 272-275.

After a discussion of the theory of cast iron, the author enters upon a description of the various experiments that have been carried out, showing the relationship between low total C and the combined C and Si contents of cast iron. The effect of low total C upon the liquid shrinkage of iron is dealt with and is illustrated by means of 5 tables. The author believes that these experiments show that liquid shrinkage is only prevented by having the requisite amount of total C present to counteract the shrinkage by its own expansion during solidification, the alternative being to make provision on the casting for risers of sufficient capacity to feed sections where such liquid shrinkage is likely to occur. The article is accompanied by 8 figures. OWE (22)

Commercial Developments in the Light-Castings Industry. Gervais Rentoul. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, page 18.

Discusses in some detail the work of the recently organized British Iron Founders' Association, which has been attempting to improve the economic conditions of the foundry industry in Great Britain, particularly in respect to unnecessary cutting of prices. Reference is made to negotiations which are under way between the Association and various merchant associations in Great Britain and Ireland to arrive at an agreement which will ensure fair play to manufacturer, merchant and consumer, alike. OWE (22)

A Contribution to the Permeability for Gases of Molding Sands. (Beitrag zur Frage der Gasdurchlässigkeit von Formsanden.) H. Viez. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 13, 1931, page 883.

An investigation is reported to define the relation between porosity and permeability for the passage of 1000 m^3 air through a standard sample. The results can be used as basis for practical standardization. Ha (22)

REFRACTORIES & FURNACE MATERIALS (24)

Study of the Shrinkage of Diaspore Clays. Stuart M. Phelps. *Journal American Ceramic Society*, Vol. 15, Feb. 1932, pages 96-106.

The development of methods which will shrink diaspore without firing to exceedingly high temperatures for long periods of time is set forth. Experimental work shows that this can be accomplished by a number of shrinkage-producing materials. It is shown that these should be added in definite percentages, and that the greatest shrinking effect will be produced by fine grinding, high pressure molding of the calcine dobies, and by firing at moderate temperatures. The effect of various gas atmospheres during calcining is pronounced. Commercial brick made by the process developed show properties superior to those of regular diaspore brick. WAT (24)

Refractories Made in Fused State. (Im Schmelzfluss erzeugte feuerfeste Stoffe.) F. Reinhart. *Tonindustriezeitung*, Vol. 56, Jan. 7, 1932, pages 32-34.

The article gives a survey of the various methods which have been proposed and are used to process refractories in fused state. The article in particular refers to patents applied for. GN (24)

High Temperature Insulation. Waldo Hutchinson. *Rock Products*, Vol. 34, 1931, pages 85-86.

Discusses the basic idea of insulation and gives graphs showing heat losses from various surfaces at various temperatures and air velocities. It is stated that air spaces are not insulators at high temperatures, owing to radiation and conversion in the space. For this reason, brick containing pores or voids large enough to be seen with the naked eye are better heat conductors at high temperatures than brick of the same material with smaller pores or no pores at all. Heat conductivity through walls and graphs are given showing the relative conductivities of various materials including fire-brick, red-brick and Sil-O-Cel products at different temperatures. The insulating property of diatomaceous silica is due to its content of as much as 85% of its volume of infinitesimal air cells. Certain calcined grades of it can be used at temperatures as high as 2500° F. Advantages resulting from insulation of furnace installations are saving in fuel, more even temperature distribution, protection of brick-work from rapid temperature changes and cooler working conditions around the furnace. WAT (24)

Structure and Heat Conductivity of Refractory Bricks. (Gefüge und Wärmeleitfähigkeit feuer fester Steine.) E. Maase. *Stahl und Eisen*, Vol. 51, July 2, 1931, pages 860-861.

The porosity of a brick can be represented approximately by the formula $m = 100\ (1-G/\gamma)$, where G is its weight and γ the specific gravity of the principal material of the body. With increasing sizes of the pores the heat transmission increases greatly. Non-metallic, amorphous substances have a low heat conductivity increasing with temperature, crystalline substances, a high heat conductivity decreasing with temperature. The temperature curves of the heat conductivity numbers assume with increasing temperature an increasingly steeper gradient. The heat conductivity increases with increasing temperature at which the brick are burned. Ha (24)

Heating Refractories from "Cold" in Fuel-Fired Furnaces. M. H. Mawhinney (Electric Furnace Co.). *Iron Age*, Vol. 128, Dec. 17, 1931, pages 1556-1559, 1584.

The first of a series of 2 articles dealing with the absorption of heat by the refractory lining of furnaces or other apparatus which is heated by gases resulting from the combustion of a fuel. The results of the tests showed: (1) a furnace to be operated at an average temperature of 1600° F. is "heated up" when the temperature of the lining at a depth of 2 ins. from the inside temperature is 75% of furnace temperature; (2) the time required depends on the rate of firing and final temperature required; (3) the time required for the same rate of firing and the same final temperature is practically independent of the wall construction and the amount of insulation; (4) the amount of fuel required to heat the furnace to a given temperature in a given time is independent of the wall construction; (5) variable rate of firing during heating up, with the highest at the start is more efficient than a constant rate equal to the average of the variable rate; (6) the most efficient average rate of firing for the variable rate, expressed in B.t.u. liberated hourly in the furnace/ft.^{2} of interior area of lining, is about 10,000-12,000 B.t.u.; (7) in gas fired furnaces, the use of gas burners when heating up only, will save time and fuel during heating up periods. VSP (24)

Refractory Materials for the Induction Furnace. J. H. Chesters & W. J. Rees. *Engineering*, Vol. 131, June 12, 1931, pages 775-776; June 26, 1931, pages 844-845.

Condensed from paper read before the Iron and Steel Institute, London, May 1931. See *Metals & Alloys*, Vol. 2, Sept. 1931, page 190. LFM (24)

Welded Zigzag Windings and Refractory Shapes for High-Temperature Furnaces. L. Navias. *Journal American Ceramic Society*, Vol. 14, May 1931, pages 365-375.

A brief account is given of published methods for making high-temperature furnaces using W and Mo windings placed both internally and externally with respect to the furnace tube. Several new methods for furnace construction are mentioned, and details are given of windings and refractories for furnaces reaching 1600° C. and 2000° C. The windings are protected from oxidation by hydrogen. WAT (24)

Modern Refractories Meeting Increased Service Demands. *Steel*, Vol. 88, Feb. 5, 1931, pages 54, 63.

Developments in the refractories industry for the past year include an increase in the amount of monolithic construction used in forging and heating furnaces, a wider utilization of chromite ore refractories and of chromite and magnesite brick, a greater use of fire brick for boiler furnace hearths, the development of acid-resistant refractories for furnaces using fuel oil, and the construction of several specially designed hearths. JN (24)

Steel Industry Using Less Magnesite Refractories. *Steel*, Vol. 89, July 16, 1931, pages 56-59.

The high cost of magnesite has stimulated the use of dolomite and chromite. Some statistics are given. Ha (24)

GASES IN METALS (25)

The Influence of Titanium Tetrachloride on the Gas Content and Grain Size of Aluminum and Some Alloys. W. Rosenhain, J. D. Grogan & T. H. Schofield. *British Aeronautical Research Committee, Reports & Memoranda* No. 1385, Nov. 1929, 10 pages.

The results of experiments to determine the effect of titanium tetrachloride in aluminum alloy castings are discussed. Titanium tetrachloride when passed into molten aluminum appeared to behave in the same way as chlorine and boron trichloride. It reduced the grain size of aluminum castings and did not appear to alter the eutectic structure in the crystal. The reduction in grain size persisted after remelting even when the molten metal was heated to 780° C. It removed gases from, reduced the grain size of, and did not "modify" the 12% silicon alloy. It improved the soundness of cast Y-alloy and decreased the grain size of the cast material. By yielding sound material of fine grain, it enabled cast slabs of Y-alloy 1.5 in. thick to be rolled without the employment of the usual preliminary forging operation. It is concluded that the fine grain produced in Y-alloy by the action of titanium tetrachloride would prove of value both in the production of sound castings for rolling into bars and sections, and for the production of large forgings. WAT (25)

Gas Removal and Grain Refinement of Aluminum Alloys. W. Rosenhain, J. D. Grogan & T. H. Schofield. *British Aeronautical Research Committee, Reports & Memoranda* No. 1387, Jan. 1930, 8 pages.

It has been shown (Report No. 1385) that titanium tetrachloride acted as an effective agent both for gas removal and grain refinement. In this report it is shown that these properties are independent. See *Metals & Alloys*, Vol. 1, Nov. 1930, page 856. WAT (25)

Iron-Hydrogen System (Bemerkung zu dem System Eisen-Wasserstoff). A. Sieverts & H. Hagen (University of Jena). *Zeitschrift für physikalische Chemie*, Sect. A, Vol. 155, July 1931, pages 314-317.

The solubility of H in iron powder was redetermined at 800° and 1000° C. and found to be as large as is the case with iron wire and sheet iron. Discrepancies met with in the measurements of Iwasé are ascribed to the O content which is difficult to entirely eliminate in reduced iron. EF (25)

The Solution of Oxygen in Silver. J. H. Simons. *Journal of Physical Chemistry*, Vol. 36, Feb. 1932, pages 652-657.

An article, accompanied by 2 tables, in which experiments are described that indicate that the O retained by rapidly cooled Ag is in the form of silver oxide and not atomic oxygen. The assumption that the O so dissolved is present as silver oxide is used to explain the solution of O in molten Ag and in solid Ag. The solubility curve of silver oxide in solid Ag has been calculated. OWE (25)

The Absorption of Nitrogen by Iron (Die Absorption von Stickstoff durch Eisen). A. Sieverts. (University of Jena.) *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 155, July 1931, pages 299-313.

The absorption ability of α, β and γ Fe for N_2 at atmospheric pressure in relation to the temperature is as follows:

°C.	750	890	910	1000	1050	1100	1150	1190
	α	β	γ					
mg. N_2/100 g Fe	0.4	2	25.0	22.5	21.1	19.8	18.5	(18.2)
N : 10,000 Fe (atoms)		0.8	10.0	9.0	8.4	7.9	7.4	(7.3)
Vol N_2/1 Vol Fe		0.13	1.57	1.41	1.33	1.24	1.16	(1.14)

Fe saturated with N retains varying quantities of N depending on the conditions of cooling-down and on the relative size of the metallic surface. The maximum value amounts to about 0.03% N. The diffusion rate of nitrogen dissolved in iron decreases with falling temperatures and is minute below 600° C. At constant temperatures the amount of nitrogen absorbed by γ Fe proved to be proportional to the square root of the N pressure. EF (25)

The Influence of Atmosphere on the Scaling of Mild Steel. W. H. Blackburn & J. W. Cobb. *Blast Furnace & Steel Plant*, Vol. 19, Feb. 1931, pages 273-276.

The object of the present investigation was to determine, by laboratory experiments carried out under carefully controlled conditions, what steps could be taken to reduce the amount of scaling of a mild steel having regard to fuel economy and also to the possibility of reducing or eliminating the smoke nuisance consequent on the use of a smoke flame. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 323. Ha (25)

Oxygen in Cast Iron. *Metallurgist*, Oct. 1930, pages 152-154.

A critical review of a large number of references on the effect of O in cast iron. VVK (25)

Effects of Furnace Atmosphere. J. A. Comstock. *Heat Treating & Forging*, Vol. 17, Sept. 1931, pages 899-902, 905.

A review of the effects of oxidizing, reducing and neutral atmospheres and means of obtaining and controlling them. Ha (25)

The Influence of Cyanogen Upon Zinc (Ueber die Einwirkung von Cyan auf Zink). H. Braune (Technische Hochschule Hanover). *Zeitschrift für physikalische Chemie*, Bodenstein Festband, 1931, pages 415-422.

The reaction speed of the reaction between solid Zn and cyanogen gas, which attacks metals even at low temperatures, has been determined over the temperature range from 0°-115° C. The activation heat of the reaction considered amounts of 13.4 kcal. EF (25)

Effect of Carbon Gases on Steel. Murray Winter & P. B. Crocker. *Heat Treating & Forging*, Vol. 16, Nov. 1930, pages 1450-1451.

A series of tests were conducted to determine the effect of C gas on the surface condition of high speed steel when heated preparatory to hardening. It appears that the proper atmospheric condition demands a considerable percentage of carbon monoxide, about 25-30%, if scale and soft surface is to be avoided. For this reason, electrically heated furnaces filled with hydrocarbon gas did not give very satisfactory results. Ha (25)

INSPECTION (26)

Gages for Sheet Metal. *National Bureau of Standards Circular* No. 391.

Stock sizes of metal sheets and plates are based either on definite thicknesses or definite weights/unit area. Such a list of thicknesses of weights constitutes what is known as a "gage." In the United States there are several gages in use for sheet metal, a situation which frequently causes confusion and inconvenience in the trade. In order that definite information covering the entire field might be available, the *National Bureau of Standards* has issued *Circular* No. 391, which presents customary practice as to standard thicknesses, weights, and tolerances of sheet metal. It is not the purpose of the circular to promulgate standards, although some of the gages included are officially recognized standards, but merely to make readily accessible information as to current practice. The gages dealt with are those which apply to the following metals and alloys: wrought iron, steel, commercially pure open-hearth iron, saw steel, zinc-coated or galvanized iron and steel, tin plates, terneplates, Cu, Al, brass and other nonferrous alloys, Monel metal, Zn and Pb. The circular also includes gages or stock lists for sheet metal widely used in Europe, particularly England, France, Germany, and in Japan. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each. WAT (26)

Testing of Pre-Heater Parts. (Abnahme von Vorwärmerteilen.) Nürnberger. *Die Wärme*, Vol. 54, Apr. 25, 1931, pages 326-328. Sonderheft "Werkstoff und Herstellung im neuzeitlichen Dampfkesselbau."

The materials used for the construction of pre-heaters and their testing are discussed in this lecture before the Zentralverband der Preussischen Dampfkessel Überwachungs-Vereine, 1931. EF (26)

Acceptance Tests of Gear Steel. *Metal Progress*, Vol. 18, Dec. 1930, pages 91-94.

Details of Brown-Lipe-Chapin methods of inspection of steel for automotive gears are given covering features of cleanliness, structural normality, grain size, hardenability and chemical analysis. WLC (26)

Building and Inspecting Boilers for the U. S. Navy. W. A. Brooks. *Boiler Maker*, Vol. 31, June 1931, pages 146-150.

The procedure followed in equipping a naval vessel with boilers and the requirements which such boilers must meet are described. Materials and test methods are discussed. Ha (26)

Simple Methods for Inspecting Spring Steels. H. J. Malafey. *Machinery*, Vol. 75, July 1931, pages 865-866.

Description of a portable equipment for applying hardness tests to hardened and tempered spring steel specimens for the purpose of determining the strength and quality of purchased stock. A table showing the effect of heat treatment on the hardness at different tempering temperatures is given. Ha (26)

Measurements in Mass Production. (Messungen im Austauschbau.) G. Berndt. *Archiv für Technisches Messen*, 1931, pages T53-54, Section V83-0.

In order to safeguard the exchangeability of parts produced in quantity, tolerances are specified which must be strictly observed. The fundamentals and definitions of units and the technical measuring system are explained and the errors due to observation and to measuring instruments discussed. The importance of the German DI-standards is pointed out. Ha (26)

Radiographic Inspection of Welded Structures. H. R. Isenburger. *Boiler Maker*, Vol. 31, Oct. 1931, pages 258-263.

The high voltage equipment for X-ray inspection is described and defects in welds explained by means of micrographs. An exposure chart, times required for different thicknesses of steel is added. Ha (26)

Results of X-Ray Tests of Pressure Gas Containers. (Ergebnisse von Röntgenprüfungen an Druckgasflaschen.) C. Kantner & A. Herr. *Autogene Metallbearbeitung*, Vol. 25, Jan. 15, 1932, pages 17-25.

Tests on the density and metallographic examinations of steel containers for compressed gases are discussed and critically reviewed with respect to the safety of such containers; in general, former observations on the same subject are corroborated. The experiments made over a number of years permit the conclusion that the X-ray tests of pressure containers can be made safely and quickly with simple arrangements and should be checked by metallographic investigations. The processes used in the manufacture of the containers can be recognized by exposures of the bottom; the characteristics of each process and of defects as they appear in the X-ray picture are described and illustrated. Ha (26)

Weighing Thin Sheets to Measure Thickness. F. V. Hartmann. *Machinery*, Vol. 37, Feb. 1931, pages 430-432.

Metal sheets of Al 0.00025 in. thick were weighed to determine their thickness because they could not be measured exactly enough. A special press was developed to cut the specimens so accurately that the error in weighing them for the calculation of the thickness is negligible. Ha (26)

Magnetic Testing of Pipe Welds is New Inspection Method. H. R. Simonds. *Steel*, Vol. 88, Mar. 5, 1931, pages 39-42.

A magnetic testing outfit built by the Ferrous Magnetic Corporation, New York, is described for magnetic and X-ray testing; photographs are shown and the defects pointed out. Ha (26)

Detecting Defects in Heavy Castings by the Gamma Ray. *Foundry Trade Journal*, Vol. 45, Dec. 24, 1931, page 398.

A brief article outlining the recent developments by Mehl in the use of gamma rays for examination of heavy castings. OWE (26)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

The Influence of Chemical and Physico-chemical Reactions at the Surface of High-melting Metals on the Thermal Emission of Electrons. (Der Einfluss chemischer und chemisch-physikalischer Vorgänge an der Oberfläche hochschmelzender Metalle auf die glühelektrischen Eigenschaften.) K. Becker. *Physikalische Zeitschrift*, Vol. 32, July 1, 1931, pages 489-507.

The effect of gases (H, N, O, Ar), electro-positive (Hg, alkaline and earth alkaline) and electro-negative vapors (H_2O, P, I) and of oxides (of Th, Yt, La, Ce, Zr, U) on the thermal electron emission of high melting metals is reviewed. Four different types of phenomena due to chemical and physico-chemical reactions of foreign atoms encountered at the surface of high melting metals are specified. 94 references. EF (27)

Titanium in Rail Steels (Le titane dans les aciers à rails). *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Apr. 1931, pages 191-192.

Ti in steel reduces the segregation in the center. Usual amount of Ti in steel is just below 0.10%. GTM (27)

Alloy Cast Irons. Gerald S. Bell. *Foundry Trade Journal*, Vol. 45, Dec. 3, 1931, pages 353-354; Dec. 10, 1931, pages 365,368.

A general article on the subject of alloy cast iron, in which the effects of Ni in gray iron are dealt with, and in which the applications of pearlitic Ni cast iron are discussed. The effects of Cr additions to cast iron are dealt with, and the necessity for controlling the ratio of Cr to Ni to suit the class of casting being poured and the desirability of making allowance for the Ni and Cr content in the Si content of the basic mixture is referred to. The article is accompanied by two photographs. OWE (27)

The Effects of Impurities on Copper. Part VII.—The Effect of Antimony on Copper. Part VIII.—The Combined Effect of Antimony and Arsenic on Copper. S. L. Archbutt & W. E. Prytherch. *Engineering*, Vol. 131, June 12, 1931, pages 777-779.

Condensed from Communication from The National Physical Laboratory, read before the Institute of Metals, London, March 12, 1931. See *Metals & Alloys*, Vol. 2, June 1931, page 121. LFM (27)

Investigations on the Restriction in Using Gray Cast-Iron of Various Compositions. (Untersuchungen über die Einschränkung im Gebrauch von Grauem Gusseisen verschiedener Zusammensetzung.) E. Balma. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, page 922.

The objections against gray-iron in the construction of motors are shown to no longer be valid since an addition of Cr and Ni produces very suitable material. Both elements must be present, the best and most economic is a high content of Cr and a low of Ni. Ha (27)

The Influence of Silicon on Nickel Steel. R. Harrison. *Engineer*, Vol. 152, Oct. 2, 1931, pages 347-348.

Abstract of a paper read before the Iron & Steel Institute, Swansea, Sept. 1931. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 323. LFM (27)

Foundry Research in 1931. Harold Hartley. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, pages 21-23.

An article dealing in the main with the work carried out in 1931 by the British Cast Iron Research Association. Special attention is directed to the recent discoveries regarding the effect of Si upon gray iron, particular note being made of the recently developed heat-resisting alloy "Silal." The influence of total carbon upon the properties of iron is referred to, and the conditions of melting are carefully discussed. The effects of Ni and Cr are then dealt with, and attention is directed to a high Si iron similar to "Silal" in Si and C content but containing Cr and Ni. Two photomicrographs of typical sections of this alloy accompany the article. The question of the soundness of castings is referred to, and a discussion of the test bar problem concludes the article. OWE (27)

Silicon as an Alloying Element. J. Arnott. *Engineering*, Vol. 132, July 3, 1931, page 10.

Abstract of a paper read before the Institute of British Foundrymen, June 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 282. LFM (27)

Role of Sulphur in Corrosion Resistant Steels. Correspondence from F. R. Palmer, Reading, Pa. *Metal Progress*, Vol. 21, Feb. 1932, pages 70 and 88.

The effect of S up to 0.30% in stainless steels to improve their machining properties is discussed. WLC (27)

Effect of Composition on Aluminum-base Die-casting Alloys. D. L. Colwell. *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 1, pages 268-279.

Includes discussion. See abstract of preprint, *Metals & Alloys*, Vol. 2, Oct. 1931, page 230. HWG (27)

Aluminum Improves Malleable Cast Iron Properties. John H. Hruska. *Foundry*, Vol. 59, Jan. 1, 1931, pages 70-71.

An addition of 0.04% Al to malleable iron resulted in a maximum increase of tensile strength and elongation (53,900 lbs./in.^{2} and 21% for 2 ins., respectively). With larger additions, the fluidity of slag and metal was influenced; both became more sluggish with increasing amounts of Al. Ha (27)

Aluminum, Chromium and Manganese in Gray Cast Iron. (Aluminium, Chrom und Mangan in Grauguss.) E. R. Thews. *Die Metallbörse*, Vol. 21, Feb. 7, 1931, pages 244-245.

The present state of Al, Cr and Mn additions to gray cast iron is reviewed as reflected by statements in literature. 25 references. EF (27)

Vanadium has Marked Effect on Properties of Steel. *Steel*, Vol. 89, July 23, 1931, page 33.

V acts both as a scavenging agent to clean the molten bath and as an alloy in the finished metal; the first action consists in uniting with undesirable O and N and carrying them off in the slag. As an alloying material it increases strength, hardness and resistance to abrasion and fatigue; the tendency of the elements to segregate during the cooling period is decreased. The properties are discussed more in detail. Ha (27)

INSTRUMENTS & CONTROLLERS (28)

Electrical Instruments Uncover Hidden Shop Losses. A. G. Baumgartner (General Electric Co.). *Iron Age*, Vol. 128, Dec. 17, 1931, pages 1537-1542, 1584.

Gives a detailed picture of the application of electrical devices to machines as well as other uses in the plant. Absorption dynamometers function not only in the capacity of supplying loads for a machine but also provide the means of measuring the load. In this group are placed the Prony brake, hydraulic and fluid friction brakes, fan brakes, electromagnetic and electric brakes. Principal forms of transmission dynamometers are the levers, torsion and cradle types. Indicating instruments give the momentary value of quantity which they are measuring. Indicating instruments in general are applied to loads which are relatively constant for appreciable intervals. Recording instruments, in general, are instruments so arranged that accurate records of needle fluctuations are obtained. Various applications of electrical instruments in the machine tool field are described. VSP (28)

Photoelectric Tubes Control Sheet Mill Run Out Tables. A. F. Bowers. *Steel*, Vol. 89, Aug. 20, 1931, page 38.

The layout of the installation is described. Ha (28)

Practical Measurement of Time of Impact for the Determination of Steam Consumption in a Manual Forge. (Praktische Erprobung der Schlagzeitmessung zur Ermittlung des Dampfverbrauchs in einer Freiformschmiede.) W. Mecklenbrauck & Walter von Chilingensperg. *Stahl und Eisen*, Vol. 51, Jan. 8, 1931, pages 49-51.

The electrical and mechanical devices arranged on a steam hammer in order to measure as exactly as possible impact time and the time during which the hammer was actually under steam in order to gain more definite values of the steam consumption for a certain forging operation are described in detail and records reproduced. Ha (28)

Temperature Measurement—Electrical and Optical Devices Used in Pyrometry. P. M. Hogg. *Electrician*, Vol. 107, Nov. 27, 1931, pages 736-738.

An abstract of an address on "The Application of Electricity to the Measurement of Temperature, "read before the Mersey and North Wales (Liverpool) Center of the Institution of Electrical Engineers, Oct. 19, 1931. The types of pyrometry reviewed are: resistance, thermo-electric, and radiation. The latter may be divided into (1) total radiation pyrometry and (2) optical pyrometry. WHB (28)

The Measurement of the Gaseous Products in the Foundry. (La Mesure des Débits Gazeux en Fonderie.) H. Laplanche. *Revue de Fonderie Moderne*, Vol. 25, Dec. 25, 1931, pages 453-463.

The desirability of determining quality and quantity of gases escaping from the foundry with regard to whether too much or too little air is used in certain combustion processes is discussed and the different methods and principles of measuring gas flow and metering instruments are described. Ha (28)

Temperature Measuring Instruments in Foundries. (Temperatur Messgeräte in Metallgiessereien und Schmelzwerken.) *Die Metallbörse*, Vol. 20, Nov. 8, 1930, pages 2491-2492; Nov. 22, 1930, page 2588; Nov. 29, 1930, pages 2635-2636; Dec. 6, 1930, pages 2683-2684; Dec. 13, 1930, pages 2732-2734; Jan. 3, 1931, page 5, Jan. 10, 1931, pages 52-53.

A most complete review of the present state of temperature measuring technique with reference to metallurgical melting processes and foundry operations is given comprising the following types of instruments: (1) mercury thermometer, (2) electric resistance thermometer, (3) thermoelectric pyrometers and (4) total radiation and optical pyrometers. The paper contains 25 illustrations and 12 references. EF (28)

Thyratron Tubes Maintain Tension in Wire Drawing Equipment. *Steel*, Vol. 89, July 16, 1931, page 54.

The re-reeling coils are driven by a direct-current motor whose speed is controlled by a thyratron tube which lets more or less current pass to make the speed of the motor conform to the drawing speed of the wire. Ha (28)

Remote Metering in Steel Mills. II. The Application of the Electric Remote Metering Methods (Fernmessen auf Eisenhüttenwerken. II. Die Anwendung der elektrischen Fernmessverfahren). B. von Sothen. *Archiv für Eisenhüttenwesen*, Vol. 5, Aug. 1931, pages 81-93.

Report 153 of the Committee on Heat of the Verein deutscher Eisenhüttenleute. The paper deals with the application of the electric remote metering methods in metallurgical plants, such as blast furnace plants, open hearth plants, rolling mills, gas producer plants and Thomas steel plants. It also deals with the equipment for controlling heat, gas, water, compressed air and electric current. A detailed illustrated description is given of the various devices that are employed and suggested for the above purposes with special reference to the equipment that has been installed in the various plants of German steel mills. The paper notes the possibilities of development in the field of remote metering devices. GN (28)

Precision Measuring Instruments Used by the German Machinery Industry. O. P. van Steewen. *American Machinist*, Vol. 75, Oct. 22, 1931, pages 620-622, Oct. 29, pages 666-668, Nov. 5, pages 704-707.

2 main expedients to manufacture with greater economy were used in Germany: (1) systematic establishment of standards by the German Industrial Standardization Committee; (2) enlistment of the optical industry for the purpose of cheapening and simplifying measuring methods. The latter measure consisted in refining the inspection methods in order to exclude the personal factor and obtain closer tolerances. A great number of gages, microtasts, internal gages, gear testers, etc., are described and their function explained. Ha (28)

Temperature Measurement on Liquid Cast Iron (Temperaturmessung an flüssigem Gusseisen). J. Möller. *Dinglers Polytechnisches Journal*, Vol. 345, Nov. 1931, pages 206-208.

Problems associated with the temperature measurement of cast iron and use of the "Pyropto" instrument, built by the Hartmann & Braun Co., Frankfurt. EF (28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Zinc Alloys for High- and Low-Temperature Service. H. A. Anderson (Western Electric Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.—A.S.M.E. Joint Research Committee*, 1931, pages 271-289.

See *Metals & Alloys*, Vol. 2, Dec. 1931, page 325. WAT (29)

Boiler Material which is only slightly Subject to Aging. (Gering alterunge empfindliche Kesselstoffe.) E. Franke. *Die Wärme*, Vol. 54, Jan. 3, 1931, pages 6-7.

The phenomenon of aging is briefly anticipated and it is shown why ordinary wrought iron is unfitted for highly stressed boiler plate. Among the boiler material which displays minor tendencies towards aging are the Izett Steel, low alloyed Ni-steels, low C wrought iron with additions of V or Mo and the Cu-bearing Union Baustahl. These are discussed with reference to their superior properties as boiler plate. In conclusion attention is called to the smaller wall thickness if alloy steel is employed and to the testing for aging of material in the as-received state. EF (29)

Methods of High Temperature Treatment. Paul P. Cioffi (Bell Telephone Laboratories). *Journal Franklin Institute*, Vol. 212, Nov. 1931, pages 601-612.

Treating metals, chiefly iron and its alloys, at all temperatures up to 1700° C. and in any atmosphere ranging in pressure from 10^{-8} mm. of mercury to 20 or more atmospheres is discussed. There are 3 rather well defined groups: (1) Long ores and tapes heated to any temperature up to a few degrees below the melting point by passing currents through them in the presence of a gas; (a) under a pressure of 1 atmosphere or less; (b) under a pressure up to 20 atmospheres. (2) Toroids heated by induction in a gas atmosphere, with the gas pressure ranging from 10^{-8} mm. to 1 atmosphere. (3) Any shape of specimen heated up to about 1700° C. (in a molybdenum wound furnace) in a gas pressure from 10^{-3} mm. to 20 atmospheres. Heat treating iron in vacuum and in hydrogen has been accomplished satisfactorily over a period of years. Illustrations of heat treatments are given. DTR (29)

Engineering Requirements and Trends for Metals in the Non-Ferrous Roasting, Smelting and Refining Industry. R. E. Brown (Electro Metallurgical Sales Corp.). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 151-168.

See *Metals & Alloys*, Vol. 2, Sept. 1931, page 191. WAT (29)

The Behavior of Steel at High Temperatures. *Engineering*, Vol. 152, July 31, 1931, pages 115-116.

From report of the Engineer-in-Chief, V. B. Harley Mason, to the Executive Committee of the Manchester Steam Users' Association. Reviews various standard methods of testing and compares the results of different investigators. Test results for ordinary C steel are compared with those for alloy steels. LFM (29)

The Thermal Conductivities of Certain Approximately Pure Metals and Alloys at High Temperatures. L. C. Bailey. *Proceedings Royal Society,* Vol. 134A, Nov. 1931, pages 57-76.

In the case of pure metals the generally accepted rule, that the conductivity decreases with increase of temperature, does not appear to hold in all cases. The conductivity of Al appears to reach a maximum at 225° C., after a decrease takes place to 550° C. The conductivity of Ag is a minimum at about 400° C., after which a rise occurs to 575° C. No other values appear to be given for Ag at these temperatures. The conductivity of Zn appears to decrease continually over a wide range of temperature from -170° to + 370° C. These results and those for Al support the view that the thermal conductivity of a metal increases as the purity of the metal increases. The results for Cd indicate that an abrupt fall and rise of conductivity takes place near 50° C., after which the normal steady decrease occurs. A transition point, reputed to occur at 64.9° C. may have some connection with the change, but further work is necessary to test this. In the case of the 2 alloys tested, the rule that the conductivity increases with increasing temperature is confirmed, but the increase is not regular. The conductivity of brass increases rapidly with temperature, an approximately linear law being followed to about 125° C., after which it tends to a constant value up to 450° C. A continuous increase of conductivity of Platinoid (composition approximately that of German silver) occurs with increase of temperature, an approximately linear law being followed. WAT (29)

"Kanthal" Metal. *Jernkontorets Annaler,* Vol. 115, Oct. 1931, pages 544-547.

"Kanthal" metal is an alloy containing 60% Fe and the balance Cr, Al and Co (percentage of alloying elements not given). The structure is ferritic and is not affected by heat treatment. Its melting point is between 1650° and 1670° C. The tensile strength at room temperature is 119,000 lbs./in.^{2} with 13% elongation and 65% reduction of area. At elevated temperatures the tensile strength is:

	lbs./in.^{2}
700° C.	16800
900° C.	4600
1170° C.	1000
1300° C.	600

Between the temperatures of 700° and 1100° C., the electrical resistance is about 25% more than that of Ni-Cr-Fe alloys containing over 50% Ni and 20% Fe. If the life of an alloy containing 80% Ni and 20% Cr is estimated, for comparison, to be 35 hrs. from a viewpoint of oxidation, at 1200° C., the life of "Kanthal" metal is estimated to be between 80 and 95 hrs. WAT (29)

The Yield Point and Creep Limit of Steel at High Temperatures. *Engineering,* Vol. 132, Aug. 14, 1931, pages 203-204.

An editorial reviewing the work of Baumann, Körber and Pomp, Bailey, Hatfield, and others pointing out that there is no such thing as a true "creep limit." Greater refinements in measurement and tests of longer duration have shown that creep does in fact take place at stresses much lower than those which had at one time been regarded as limiting values. WAT (29)

Safe Internal Pressures for Aluminum Alloys and Tempers at Various Temperatures. *Data Sheet, Aluminum Company of America,* Nov. 6, 1931.

Tables and formulas are given for use in calculating the safe internal pressure for aluminum tubing and pipe (size ⅛" - 2") in various alloys and tempers, at temperatures from 75°-500° F. WAT (29)

The Mechanical Properties of Metals at Elevated Temperatures. Pierre Chevenard (Soc. Anonyme de Commentry-Fourchambault et Decazeville). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 245-270.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 191. In the discussion the Crane Company presents data on a low C steel showing results of a variable-temperature constant-load flow test. In such a step-temperature test, it is stated, 3 different stresses generally suffice to show quite well the temperature-stress-creep relationship of a metal. It is further claimed for this type of test that it reveals more clearly the temperatures at which the properties of a metal change from elastic to "viscous." In the author's closure it is pointed out that the results of such tests should be interpreted from a scientific standpoint with caution because at different temperatures under the same load the metal is not in the same condition. On the other hand from the industrial point of view the technique of such tests is of practical value when it is a matter of proceeding rapidly in the study of many metals and alloys. WAT (29)

The Maximums of the Isotherms of Electrical Conductivity of Metallic Solid Solutions (Die Spitzen auf den Isothermen der elektrischen Leitfähigkeit metallischer Mischkristalle). G. Grube & J. Hille. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 194, Dec. 9, 1930, pages 179-189.

Discussion of the conductivity isotherms for different temperatures in a continuous binary series of solid solutions. A compound is formed at decreasing temperature, which, in its turn, also forms solid solutions with the components. The 3 possible constitutions are discussed. The formation temperature of the compound A_mB_n, on account of the formation of solid solutions with the components A and B is (1) reduced by both components, (2) increased by both components, (3) reduced by one and increased by the other component. Case (1) exists in the system Au-Zn and Au-Cu. Case (2) has never been observed. Case (3) occurs in the system Cd-Mg. The relation of these phenomena with the peaks of the conductivity isotherms is discussed. Ha (29)

NCT3—A Recent Addition to the Heat Resisting Alloys. John L. Everhart. *Power,* Vol. 75, Feb. 2, 1932, page 174.

This material contains a maximum of 0.20 % C, 0.70 Mn, 0.03 S and P, 2.0 Si, 23.0-27.0 Cr and 17.0-21.0 Ni. Six months' exposure to hot flue gases, but not exposed to the flame, showed only slight scale formation at 1500° F. WAT (29)

Metal Coatings and Alloys, Resistant to High Temperatures. (Metallschutz und Legierungen, Widerstandsfähigkeit gegen hohe Temperaturen). W. Obst. *Feuerfest Ofenbau,* Vol. 7, Mar. 1931, pages 36-37.

The process of aluminum coating materials, called by Krupp "alitieren," (similar to "calorizing") is advocated. At 850° C. the Al-coated steel is said to have 10 times the life of uncoated steel. Cast iron of low graphite content may be coated after preliminary annealing at 750° C. to avoid further growth. Some general statements, but no details, are given as to Al coatings on Ni, Cu and brass. The Al-coated materials do not serve for as high temperatures as do the 18-8 steels, but the latter are more expensive. Obst states that further advances may be made through Al-Be alloys of 1280°-1300° C. melting point and high heat-resistance. WHB + HWG (29)

Influence of Unequal Heat Expansion of Rigid Connections Between Light Metal and Steel (Der Einfluss der ungleichen Wärmeausdehnung der Verbindung von Leichtmetall und Stahl). E. Straube. *Zeitschrift für Metallkunde,* Vol. 22, Sept. 1930, pages 314-315.

Numerical calculation of stresses due to different heat expansions. Checking by experiments on girders of steel-Lautal. EF (29)

Effect of Carbon and Silicon on the Growth and Scaling of Grey Cast Iron. A. L. Norbury & E. Morgan. *Iron & Coal Trades Review,* Vol. 122, June 26, 1931, page 1023.

Paper read before the Iron & Steel Institute, May 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 27. Ha (29)

New Creep-testing Apparatus at the Massachusetts Institute of Technology. F. H. Norton & J. B. Romer. *Proceedings American Society for Testing Materials,* Vol. 31, pt. 1, 1931, pages 129-135, 6 figures.

Some improvements over the creep outfits formerly used at Mass. Inst. Tech. are described. Each specimen now has its individual furnace. Winding of the furnace is such as to hold the temperature variation over the test length of the specimen within a range of 20° F. HWG (29)

High Pressures and Temperatures for Steam Prime Movers. O. Wiberg. *Engineering,* Vol. 133, Jan. 1, 1932, pages 27-28.

The results of an analysis of certain tests of materials conducted by the Stal Turbine Co. of which the author is chief engineer, are presented. The following steels were tested: (1) 0.15% C, (2) 0.50% C, (3) 0.35% C, 13.5% Cr, (4) austenitic Cr steel (Krupp V2A), (5) austenitic Cr steel (Firth H. R. Crown), (6) heat resisting alloy containing 15% Cr, 61% Ni, 7% Mo, 15% Fe and 2% Mn. These materials were tested in creep, short-time tension, and fatigue to temperatures up to 700° C. Diagrams illustrate the results. WAT (29)

Use of Metals at Elevated Temperatures in the Ceramic Industry. Clyde E. Williams (Battelle Memorial Institute). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 201-217.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 192. In the discussion it was pointed out that imperfect castings have probably been the greatest single cause of trouble in the service of cast furnace parts. The superiority of cast materials over wrought materials of the same composition for elevated temperature service is also pointed out. WAT (29)

Calculation of the Temperature of Combustion of a Few Metals (Versuch zur Berechnung der Verbrennungstemperatur einiger Metalle). Ilja Westerman. *Metall und Erz,* Vol. 27, Dec. 1930, pages 613-619.

The temperatures of combustion for various metals are determined by plotting the heat content of the metal as a function of temperature. A line is drawn from the ordinate corresponding to the heat of combustion of the metal, and the abscissa corresponding to the point where this intersects the heat-content curve represents the combustion temperature of the metal. The following results were obtained: Pb 1470° C., Sn 1950° C., Zn 1800° C., Cd 1385° C., Bi 1890° C. WAT (29)

Properties of Copper and Some of Its Important Industrial Alloys at Elevated Temperatures. W. B. Price (Scovill Manufacturing Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 340-367.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 231. In the discussion the American Brass Company presents additional data on short-time tensile tests, between room temperature and 610° F., on 17 alloys of Cu containing various amounts of Zn, Sn, Fe, Ni, Pb, and Al. Cu is not recommended for use at elevated temperatures as it begins to anneal at 300° F. and is completely annealed at that temperature in about 96 hours. If heated in air, begins to oxidize at 750° F., and above this temperature begins to scale. If the metal contains oxide it is seriously embrittled in atmosphere of hydrogen at elevated temperatures, but deoxidized Cu and its alloys are not affected by hydrogen in this way. Short-time tensile strength data are given by the Crane Company on yellow brass, red brass, and cast bronze for temperatures between room temperature and 800° F. Al bronzes, containing 9 to 10% Al, have the strength at 1650° F. that ordinary 5% Sn bronze has at room temperature; the Al bronzes do not scale at this temperature. Cu-Ni alloys retain more strength at high temperatures than most other Cu alloys. A chart is given showing the short-time tensile strength of a 70-30 Ni-Cu alloy (Monel), between room temperature and 1500° F. A Cu-Si-Mg alloy (Everdur), retains one-half its original strength at 750° F. A Cu-Ni-Al-Si alloy, (Tempaloy) has good physical properties to 840° F. A comparison is made of the short-time tests and creep tests on Monel metal between room temperature and 1300° F. and short-time tensile properties, including proportional limit, of 8 alloys of Cu, containing various amounts of Ni-Zn-Fe and Mg, are given for temperatures up to 1000° F. Creep tests at 500° F on three alloys containing (1) 88% Cu, 10 Sn, 2 Zn, (2) 88 Cu, 6 Sn, 4 Zn, 2 Pb, and (3) 85 Cu, 5 Sn, 5 Pb are reported from the Lunkenheimer Company. WAT (29)

On the Resistance of Lead and Tin to High Frequency Currents at Superconducting Temperatures. J. C. McLennan. *Transactions of the Royal Society of Canada*, 3rd Series, Vol. 25, Sec. 3, May 1931, pages 191-193.

The author points out that as a result of an interesting observation on the behavior of Pb it appeared desirable to investigate whether there was any actual difference between the temperature at which superconductivity appeared with rapidly alternating currents and that at which it came on when direct currents were used. In the case of Pb it had been shown that with currents of frequency 1.1×10^7 per second an abrupt loss of resistance of relatively large amount occurred at a temperature slightly lower than the critical temperature 7.2° K, characteristic of the transition to superconductivity found for the metal with direct current. Experiments with Sn revealed the fact that with direct currents the resistance began to decrease abruptly at 3.76° K, disappearing completely at 3.70° K. The same Sn, with currents of frequency 1.1×10^7, gave for the corresponding temperatures 3.67° K and 3.61° K—i.e., superconductivity did not begin to appear until a temperature was reached that was below the one at which it was complete in the case of the direct current experiments. A brief discussion of possible explanations of these phenomena follows. OWE (29)

On the Dilatation of Superconductors. J. C. McLennan, J. F. Allen & J. O. Wilhelm. *Transactions of Royal Society of Canada*, 3rd Series, Vol. 25, Sec. 3, May 1931, pages 1-12.

The authors, desiring to answer the question, whether Pb maintained at a temperature of 4.2° K and subjected to a magnetic field sufficient in strength to restore its resistance, would undergo a change of length of the same character and of the same amount that it exhibited when its temperature was raised from 4.2° K to 7.3° K without any magnetic field being present, studied the thermal and magnetic dilatation of Pb and of Rose's metal in the neighborhood of liquid helium temperatures. Both these materials have conveniently high super-conducting points. Materials having high transition temperatures were necessary, since optical and other considerations made observations through liquid helium impossible; temperatures above 4.2° K had to be employed. The results of the investigation on thermal expansion were not as satisfactory as might have been possible, had apparatus of high sensitivity been available. A somewhat higher accuracy was obtained in the measurements of magnetic dilatation. The apparatus used by the authors is fully described and diagrams referring to it are included. The paper is illustrated by 5 diagrams and is accompanied by 2 tables. OWE (29)

Tests on Enduro Firebox Plate. H. L. Miller. *Boiler Maker*, Vol. 31, May 1931, pages 127-128.

Comparative tests with a regular sheet equipped locomotive showed that the carbon steel plate had deteriorated sufficiently after 69,400 miles of service to necessitate removal, while the Enduro plate (a high-chromium iron) was in good condition, so far as resistance to corrosion and cracking was concerned. By driving new staybolts, however, cracks occurred and it seemed evident that room temperature is not suitable for this operation. A temperature near the boiling point of water is recommended. Ha (29)

Measurements with the Aid of Liquid Helium. XII. Plasticity of Metal Crystals at the Lowest Temperatures. (Messungen mit Hilfe von flüssigem Helium. XII. Plastizität von Metallkristallen bei tiefsten Temperaturen). W. Meissner, M. Polanyi & E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 18, 1931, pages 30-34.

In Zn and Cd crystals there is not much difference in the stress for beginning of deformation between room temperature and 1.2° absolute (obtained with liquid He). At the very low temperatures the rate of application of load has little effect. Flow under such conditions is athermic, not affected by temperature. Flow of amorphous materials on the contrary is vastly affected by temperature. The partial distortion of the crystal structure occurring on deformation brings the plastic behavior of the crystal nearer to that of an amorphous body. Athermic deformation causes hardening, and this is opposed by thermal softening (crystal recovery or recrystallization). At medium temperatures the deformation curves depend on temperature and rate of loading. The apparatus and methods used for determining deformation curves at the temperature of liquid He are illustrated and described. HWG (29)

Tests of the "Creep" of Lead Cable Sheathing Under Steady Load. H. F. Moore. *Bulletin, Utilities Research Commission*, Vol. 2, Oct. 1931, pages 1, 3, 4.

Creep curves on Pb at room temperature have the same general form as high temperature creep curves for steel. Semi-log plotting of stress versus time for 1% creep indicate the existence of a creep limit at about 200 lbs./in.², with little variation between 32° and 150° F. The alloys of Pb with Sb or Sn creep less rapidly at higher stresses than pure Pb, but appear to have no higher creep limit. Tensile creep on specimens cut from cable sheath and expansion in diameter of sections of sheath under constant internal oil presure lead to similar results. HWG (29)

The Cold Treatment of Certain Alloy Steel. G. V. Luerssen & O. V. Greene (Carpenter Steel Co.). *American Society for Steel Treating, Preprint* No. 24, 1931, 44 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. 12 references. 18 micrographs illustrate the structures studied. The paper points out certain "borderline" type of alloy steels between austenitic and martensitic or pearlitic which show appreciable hardening on cooling to low temperatures. Studies of 2 Cr-Ni, 2 Ni-Si steels and a 17½%Cr-5%Ni stainless steels are reported. The properties developed by such treatments are given. The great possibilities of such treatments are pointed out and the many advantages that may be secured in the properties of alloys susceptible to such treatment are discussed. WLC (29)

The Influence of Atmosphere and Temperature on the Behavior of Steel in Forging Furnaces. D. W. Murphy & W. E. Jominy. *Engineering Research Bulletin*, No. 21, *University of Michigan*, Oct. 1931, 148 pages.

When steel is heated prior to forging, the quality of the metal may be injured unless attention is paid to the control of the gases surrounding the metal and the temperature to which the steel is heated. In an oxidizing atmosphere produced by the use of excess air scale forms rapidly, and at high temperatures the steel is permanently injured by burning. In a reducing atmosphere, that is by firing with a deficiency of air, scale forms to a smaller extent and the burning temperature is raised. Heating plain C steels to temperatures near the burning point did not seem to affect any of the common physical properties associated with tensile tests when the steel was subsequently annealed or heat treated. The scaling increases with increasing time of exposure and temperature, and the scaling losses increase considerably with the presence of even small amounts of sulphur dioxide in the furnace gases. The sulphur content of the steel itself increases by absorption of sulphur from combustion gases carrying sulphur dioxide. The best fuels for forging furnaces should therefore be low in sulphur content. Fast rates of heating were not found to cause injurious temperature gradients in steel sections up to 4" square. The rate of heating is known to be in part a function of the composition of the gases, since the luminosity and hence the radiating power of a flame increases as the proportion of fuel to air increases. For details of test methods and test results the paper must be referred to. Ha (29)

High Temperature Characteristics of Metals Revealed by Bending. H. Scott. *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 2, 1931, pages 129-156.

If a metal strip is held in a bent position, as by placing it in a curved slot, and heated, any plastic deformation under that strain and temperature will be manifested by residual curvature of the strip after cooling and removing from the slot. Devices for constraining the strip and measuring the residual curvature are described. The ratio of residual curvature to curvature of constraint is termed the "bending ratio." Plotting this against applied strain shows knees in the curves for cold rolled phosphor bronze strips having had different tempering treatments, which correspond to the proportional limits of the samples in tension tests, but indicate that there is plastic deformation below the proportional limit. At elevated temperatures, the degree of plastic deformation is greater. The knee is present at 140° C, scarcely recognizable at 180° C, and disappears above 200° C. The curves indicate that the phosphor bronze used may be loaded to around 2500 lbs./in.² at 100° C. or 900 lbs./in.² at 150° C. without plastic deformation but that at 200° C., plastic deformation will occur at any finite load. The degree of deformation shown by phosphor bronze, under given test conditions at 200° C., is reached in 80:20 nichrome at about 500° C. and in one of the age-hardened Konel Ni-Co-Ti alloys, composition not stated, at about 575° C. This bend test shows that the rate of plastic deformation increases markedly with the amount of previous cold rolling. The decrease in apparent modulus of elasticity at elevated temperatures is indicated to be largely due to initial set, which increases more rapidly with increasing temperature than does the rate of plastic deformation. This bend test is suggested as a supplement to the creep test for the study of flow of metals at high temperatures. HWG (29)

The Mechanism of Breakage of Steel. Part I. Masao Kuroda. *Rikagaku Kenkyusho Iho*, Vol. 10, Dec. 1931, pages 1085-1104.

By studying the stress-strain diagrams in tension of a very soft steel and noting the accompanying change of structure, the cause of a characteristic phenomenon in the yield point of steel was explained and the mechanism of change occurring from the yield point to the breaking point was proposed. At first, the relations between stress and strain in the tension tests at several temperatures from room temperature to 300° C. were studied. The discontinuities on the stress-strain curves are most marked at 200° C. Hence the changes of macro- and micro-structures in the several stages of breakage were observed intermittently. The tension tests were also carried out at room temperature under constant loads during which the macroscopic changes were observed and photographed. The mechanism of breakage was proposed under the following hypothesis: A mild steel consists of ferrite grains and cementite, the former being enveloped by a thin film of the latter. There exists a layer of solid solution of ferrite dissolving carbon in supersaturation; a brittle honey-comb structure with the cementite film being formed. This structure was termed by the author "boundary structure." From this hypothesis, the author proposed the following mechanism for breakage of steel: If the stress is applied to a mild steel composed of the ferrite and the boundary structure, the latter is cracked and broken down, when the stress is increased to the breaking point of the boundary structure, since this part is more brittle and weak than the ferrite. Lüder lines are thus formed by the cracking of part of the boundary structure and the stress at this point is the yield point. Since the ferrite resists the stress of the yield point, the remaining portion of the boundary structure is further cracked and the Lüder lines are further formed. When the boundary structure is wholly cracked by the stress of the yield point, the stress is increased, and the ferrite is deformed. The stress-strain curve above the yield point for mild steel is not similar to that of pure iron as the boundary structure can yet resist the shearing slip of the ferrite. The strength of the boundary structure is markedly affected by temperature. In the vicinity of 200° C., the structure is tough and strong, but at lower temperatures the structure is brittle. As the temperature increases, the viscosity of the boundary structure gradually decreases, and the discontinuity at the yield point decreases. This effect is most marked at about 200° C. and the discontinuity on the stress-strain curve, which is not observable at room temperature, markedly observable. TM (29)

Trends in Engineering Requirements for Metals for the Power-Plant Industry. H. J. Kerr (Babcock & Wilcox Company.). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 15-29.

For abstract of paper see *Metals & Alloys*, Vol. 2, Oct. 1931, page 231. In the discussion it was emphasized that if temperatures and pressures in power plant engineering were raised to the ultimate limits which are now known they would not exceed 3000 lbs. gage and a final temperature of 1100° F. The specifications for the component parts of boilers as proposed by Kerr are therefore not only sufficient for present-day needs but for some time to come. The creep limit of 1% in 100,000 hours as set by Kerr for safe boiler design work could probably be quadrupled and still have an ample margin of safety. Welding and thermal conductivity in this field must not be overlooked if economical advances are to be made. It is suggested that veneered or coated metals might offer interesting possibilities as applied to some of the high strength alloys. Most of the discussers are of the opinion that a stress requirement of 10,000 lbs/in.^{2} at 1300° F. as set by Kerr is rather severe and too large an order for metallurgists at the present time. The only creep value recorded which is of this order is that by Tapsell and Renfry for steel containing 0.5% C, 27% Ni, 14% Cr and 4% W. A value of 13,440 lbs. at 1292° F. is given for this steel and this is probably not based on a creep rate of 1% in 100,000 hours. WAT (29)

Behavior of Materials at Low Temperatures with Special Reference to the Lignite Trade. (Das Verhalten von Materialen bei tiefen Temperaturen unter besonderer Berücksichtigung der Braunkohlenbetriebe.) E. Krieg. *Braunkohle*, Vol. 29, Oct. 18, 1930, pages 937-947; Oct. 25, 1930, pages 960-968.

Ferritic materials increase in brittleness at low temperatures. Ni-rich austenite does not. Soft Cu does not lose ductility or become brittle at -200° C. and hard-drawn Cu acts about the same as annealed Cu. Contraction may raise the loading to so high a value that Cu may fail, but this is not due to loss of ductility. Al becomes tougher at low temperatures. Pearlitic Ni steel (0.6% C 2.3% Ni) is still tough at -80° C., but brittle at -190°. The toughness is restored on reheating to room temperature. Ferronickels of 37 to 99% Ni have good notch toughness at -20° C. but very low at -80° C., but on further cooling to -190° much of the toughness is restored. 60:40 brass retains toughness all the way down to -190° C. The notch toughness of raw steel castings and of annealed and slow cooled castings is low at low temperature, but is improved by rapid cooling from the annealing temperature. Addition of Si to steel brings the change from tough to brittle material at higher temperatures. With 5% Si, brittleness appears at 300° C., with 3% Si, about 150° C. In general, heat treated (quenched or normalized and drawn) steels are superior in low-temperature toughness to annealed steels. Wire rope for bucket conveyors, etc. should not be of too high tensile strength, since steel of 285,000 lbs./in.^{2} is more brittle at low temperatures than that of 220,000. Various suggestions are given for preventing freezing of materials to be handled, by use of magnesium chloride, etc., for winter lubrication, and so on, to reduce the load put on equipment in winter use, so as to keep from applying heavy shock to material that may be in a brittle condition. Rail failures are ascribed largely to the inelastic condition of frozen ballast, so that drainage of the road bed is desirable to avoid its freezing to too solid a mass. Snapping off of rivet heads is common in cold weather and welding is preferable to riveting, but precautions have to be taken when welding in cold weather. HWG (29)

Corrosion and Other Problems in the Use of Metals at High Temperatures in the Chemical Industries. F. H. Rhodes (Cornell University). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 100-111.

For abstract of paper see *Metals & Alloys*, Vol. 2, Nov. 1931, page 283. In the discussion the Calorizing Company states that microscopic examination of calorized tubes removed from converters of an eastern chemical company after two years service showed no signs of deterioration. The International Nickel Company reports that the longer life of pure Ni tubes in caustic evaporators over that obtained by steel tubes has justified their use and enabled the production of purer caustic. Another discusser presents data showing that low C steels having above 12% Cr are quite resistant to caustic attack and that additions of Ni to these alloys destroys the resistance offered by the Cr. WAT (29)

Secondary Effects on Hysteresis Hoops at Elevated Temperatures. (Über Nachwirkungserscheinungen an Hystereseschleifen bei höheren Temperaturen.) H. Kühlewein. *Physikalische Zeitschrift*, Vol. 32, Nov. 15, 1931, pages 860-864.

The present paper presented before the 7. Deutscher Physiker und Mathematikertag, Bad Elster, Sept. 1931, refers to tests on Fe, Ni, Fe-Ni alloys, and Fe-Ni-Co alloys in the γ range studied with the object of correlating the influence of rising temperatures to the remanence and coercive force. EF (29)

The Specific Heat of Tantalum, Tungsten, and Beryllium from 100° to 900° C. (Untersuchungen über die spezifischen Wärmen von Tantal, Wolfram, und Beryllium zwischen 100° und 900°C). A. Magnus & H. Holzmann. *Annalen der Physik*, 5th Series, Vol. 3, 1921, pages 585-613.

The atomic heat at constant pressure was found to be for Ta $6.1742 + 1.0093 \cdot 10^{-3}.t$ for W $5.8947 + 8.338 \cdot 10^{-4}.t$ for Be $3.5354 + 0.88033 \cdot 10^{-2}.t - 0.11738 \cdot 10^{-4}.t^2 + 0.61307 \cdot 10^{-8}.t^3$. A large Magnus Cu calorimeter was used and the precautions taken to get precise results are described, but the only details as to purity of the metals tested are the statements that the Fe "was the purest so far prepared," the W was "highest purity," and that Be was supposed to be 99.9% pure. HWG (29)

An Apparatus for Ballistic Ring Measurements at Elevated Temperatures. (Eine Apparatur für ballistische Ringmessungen bei höheren Temperaturen.) H. Kühlewein & H. Neumann. *Physikalische Zeitschrift*, Vol. 32, Sept. 15, 1931, pages 727-730.

A simple arrangement is described designed for accurate ballistic ring measurements on magnetic materials at elevated temperatures up to the Curie Point. The practical utilization of the equipment is demonstrated by a set of experiments with charcoal iron. EF (29)

Mechanical Properties of Low Alloy Cast Steel at Elevated Temperatures. (Mechanische Eigenschaften von niedriglegiertem Stahlguss bei erhöhten Temperaturen). F. Körber & A. Pomp. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, 1931, pages 223-236; *Stahl und Eisen*, Vol. 52, Jan. 14, 1932, page 46.

15 alloy cast steels, made in an electric furnace, were tested at room temperature, 300°, 400° and 500° C. The type composition of the steels tested varied as follows: 2 plain C steels, 0.22-0.35% C, 1.15-1.80% Mn; 2 C-W steels, 0.27-0.32% C, 0.87-0.93% W; 2 C-V steels, 0.20-0.31% C, 0.28% V; 4 C-Mo steels, 0.21-0.40% C, 0.50-0.58% Mo, 0.46-1.03% Mn; 2 Cr-Ni steels, 0.20-0.28% C, 0.52-0.56% Cr, 1.06-1.50% Ni; a steel containing 0.17% C, 1.06% Cr and 0.51% Mo; a steel containing 0.28% C, 2.52% Ni and 0.40% Mo; and a steel containing 0.33% C, 0.66% Cr, 1.86% Ni and 0.36% Mo. Yield point, tensile strength, elongation, reduction of area, modulus of elasticity and notch toughness were determined. It is shown that the Ni-Mo steels with or without Cr are superior to all other steels. Also that the Mo steels without Ni but with contents of Cr and Mn show better properties than those without Mo. The same holds true for the high Mn steel. The straight Cr, Ni, W, and V steels are inferior to the other alloy steels tested. GN (29)

Influence of Temperature on the Toughness of Aluminum Alloys. T. Kobayashi. *Memoirs Ryojun College of Engineering*, Vol. 3, No. 2 A, May 1930, pages 145-153.

The variations with temperature of the toughness of a number of commercially important Al alloys has been determined by an impact method for the interval 20° to 550° C.

Scaling of Steel at Elevated Temperatures by Reaction with Gases and the Properties of the Resulting Oxides. D. W. Murphy, W. P. Wood & W. E. Jominy. *Transactions American Society for Steel Treating*, Vol. 19, Jan. 1932, pages 193-232.

Includes discussion. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 284. WLC (29)

Mechanical and Creep Properties of Molybdenum Cast Iron. C. H. Lorig & F. B. Dahle (Battelle Memorial Institute). *Metals & Alloys*, Vol. 3, Oct. 1931, pages 229-235.

20 references. The authors report a study of the mechanical properties of cast iron with Mo content up to about 1.50%. Curves and data presented show that this amount produces the maximum benefit to the mechanical properties, hardness, tensile and transverse properties at room and elevated temperatures. The properties at elevated temperatures merit consideration of this alloy. WLC (29)

Power Station Temperatures and Tensile Strength. *Metal Industry*, London, Vol. 38, June 19, 1931, pages 617-618.

Pressures up to 3,200 lbs./in.^{2} are considered possible. The usual temperature limit is around 800° C. Hecla/ATV is the alloy adopted for turbine blades, having shown no corrosion after 7 yrs. Non-ferrous metals are used for steam fittings.

The Thermal Expansion of Some Aluminum Alloys. E. E. McCollough. *Physics*, Vol. 1, 1931, pages 334-339.

Determinations of the thermal expansion coefficients of the following metals and alloys from 25°-100° C., pure Al, pure Mg, commercial Al, electrolytic Cu and alloys of Al-Fe, Al-Mn, Al-Si, Al-Ni, Al-Cu, Al-Mg and Al-Cu Si-Mn. All the alloying elements investigated have an effect on the thermal expansion of Al. An empirical equation based upon the assumption that the coefficient of thermal expansion of the alloy is the arithmetical mean of the coefficients of expansion of Al and the alloying element, is limited in its use. The thermal expansion data for the Al-Cu alloys (2.3-9.4% Cu) indicate a maximum coefficient at about 8% Cu. The data for the Al-Mg alloys (1.5-15% Mg) indicate a minimum coefficient at about 2% Mg content and alloys containing more than 8% Mg have greater coefficients of thermal expansion than that of Al. The Al-Fe alloys (2.5-11% Fe) show a decrease in expansion with increase of Fe content. The Al-Ni alloys (3.8% Ni) show a decrease in rate of expansion with increasing amounts of Ni. The Al-Si alloys (4-16%) also show decrease with increasing Si. The Al-Mn alloys (0.5-1.5% Mn) show that at 1.5% Mn the expansion is less than it is at 0.5-1% Mn. For the Al-Cu-Si-Mn alloys, no general relations were found between the percentages of the alloying elements and the corresponding coefficients of thermal expansion. WAT (29)

The Range of Brittleness of Iron at Low Temperatures. (Ueber den Sprödigkeitsbereich von Eisen bei tiefen Temperaturen.) F. Sauerwald, B. Schmidt & G. Kramer. *Zeitschrift für Physik*, Vol. 67, No. 3/4, 1931, pages 179-183.

The breaking strength of Fe is studied as a function of the temperature. Technically soft Fe is found to become suddenly brittle at -155° C. and its dilatation small. This critical temperature rises to -90° C. for single crystals.

The Rapid Determination of "Creep" Strength. *Metallurgist*, Apr. 1931, pages 56-59.

A critical review of 7 references. VVK (29)

Torsional Modulus of Spring Materials Affected by Temperature. F. P. Zimmerli, W. P. Wood & G. D. Wilson. *Metal Stampings*, Vol. 4, June 1931, page 492.

An abstract. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 789.

Silal Heat Resisting Cast Iron. *Bulletin of the British Cast Iron Research Association*, Vol. 3, Oct. 1931, pages 35-37.

Silal is a cast iron that does not grow and is scale-resisting and shows its best mechanical properties at temperatures from 700° to 900° C. It has a tensile strength of 5000 lbs./in.^{2} at 800° C. with 1½% elongation. The report shows very satisfactory results in furnace castings and locomotive fire bars. Ha (29)

Smelting in the Lead Blast Furnace, Handling Rich Charges. I. Conditions at the Tuyère Zone. *U. S. Bureau of Mines Report of Investigations* 3096, Apr. 1931, 21 pages.

Air flow per tuyère was 130 to 600 ft.^{3}/min. except for openings entirely closed. The flow through any tuyère varied less than 10% over ½ hour periods, but several 100% for different days. From 25 to 60% of the cross sectional area at the tuyère zone was open enough to permit molten charge to flow freely. The material surrounding the free zone was semi-plastic and differed but little from the rest of the charge in composition. The shape and size of the free-smelting area changed rapidly. A narrow and elongated free-smelting zone at the tuyères near the center of the furnace gave the maximum capacity in smelting; about 25% of the total area is free of semi-plastic solids. The slag temperatures when tapped were 1070-1080° C; the Pb in the crucible 870-1010° C. As the capacity of the furnace increased, the bullion was hotter and the slag colder. Charging coke separately instead of admixed with other ingredients gave better reduction of the Pb compounds, but colder bullion and hotter slag. When the furnace ran at high capacity the smelting occurred higher up in the shaft and the molten Pb was longer in contact with hot slag. When the smelting zone was more localized at the tuyères and spread over a larger area, more complete reduction of Pb compounds ensued, the slag was melted lower in the shaft and the molten Pb had less opportunity to become hot. The air in the blast did not react until it reached the free-smelting zone. The zone of highly reducing gases was very narrow and the transition was often abrupt. Temperatures were low in the plastic zone and high in the intensely reducing zone, up to a maximum of 1400° C. With a given sinter, the loss of Pb in the slag increases with an increase in the rate of smelting charges beyond a certain point. The form of combination of the Pb in the molten charge was also a function of the time allowed for reduction. Chilled material from the tuyères in the center of the furnace past which the molten material would probably flow at a maximum rate for mechanical reasons, showed the most Pb silicate and PbS. The ratio of each of the main slag-forming ingredients in the chilled materials taken from each tuyère was fairly constant. The discarded slags contain a large part of their Pb as sulphide. Sulphides are one of the major causes for the formation of accretions, lessen the capacity of the furnace, necessitate the consumption of extra coke and scrap Fe, when in the bullion make more secondaries to be handled, and result in Pb losses in the slag. AHE (31)

Tendencies in Blast Furnace Practice. Fred. Clements. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 67-73.

The general principles of pig Fe production and their connection with practice as dictated by the economic situation in a given locality are considered. Modern trends in the preparation of ore, the fluxes used, the grading requirements in fuel, temperature control and drying of the air blast, change in the lines of furnaces, charging and distributing gear, utilization of higher quality refractories and the handling of the furnace products are discussed. CHL (31)

Modern American Metallurgical Practice. W. D. Jones. *Chemical Engineering & Mining Review*, Vol. 24, Oct. 5, 1931, pages 11-14.

An abstract of a report read before the Institution of Mining & Metallurgy, London, covering the inspection of 20 metallurgical plants in America. Pb, Cu, Zn, Fe and auxiliary and miscellaneous plants were included. See also *Metals & Alloys*, Vol. 2, Dec. 1931, page 326. WHB (31)

Smelting Secondary Aluminum and Aluminum Alloys. Robert J. Anderson. *Metal Industry*, New York, Vol. 29, Nov. 29, 1931, pages 474-476; Dec. 1931, pages 519-520.

Part 11—Metal Recoveries in Secondary Aluminum Practice. It is preferable to sell scrap on a recovery basis. The effect of the general character of the scrap, such as weight and cleanliness, of pre-treatment, such as sorting, magnetizing, cleaning, grinding, etc., and of melting and the furnace technique are all discussed in a general way. *Part 12—Recoveries secured in practice on different kinds of scrap.* Tables listing recoveries based on total weight of material handled are given on carload shipments of some kinds of drosses and on re-melting various kinds of Al and Al alloy scraps. PRK (31)

A Graphical Method for Determining the Degree of Oxidation of Fe Ores (En grafisk method för beräkning av järnmalmers oxidationsgrad). I. Sahlin. *Jernkontorets Annaler*, Vol. 115, Sept. 1931, pages 484-486.

A graph is constructed from which the degree of oxidation of Fe ores may be read directly when the percentages of the various oxides present are known. HCD (31)

Smelting in the Lead Blast Furnace. Handling Rich Charges. VIII. The Gases From the Top of the Furnace. *U. S. Bureau of Mines Report of Investigations* 3095, Apr. 1931, 19 pages.

The composition of gas issuing from the top of the charge in the Pb blast furnaces at Kellogg, Id., varied greatly, - O_2 from a few tenths to 20%, CO up to 15%, CO_2 10-28% and usually 20-28%, and H_2 up to 0.5%. Temperatures were 100-1100° C. There was a general tendency for the gas to be a little richer in CO in areas near the slag tap. In operating at forced capacity (coke 10-12%), maximum CO and maximum temperatures were higher above the tuyères than at Tooele. Change from oxidizing to reducing conditions was very rapid. The furnace acted both as a blast roaster to oxidize sulphides and to reduce Pb compounds to metal. From 10 to 12 tons of dust/furnace/day was made. The major constituents were volatilized products, chiefly Pb, with lesser Cd and Zn. Fe oxides, CaO and insolubles were small in amount. The gases are diluted 6 or 7 parts to 1 by the time they reach the bag house (for cooling purposes). AHE (31)

Some Recent Developments in the Mechanical Charging of Blast Furnaces. Geo. B. Garrett. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 105-108.

American practice in the mechanical charging of a blast furnace is given. CHL (31)

Purification of Zinc Ores in Sintering. Reed H. Hyde. *Mining & Metallurgy*, Vol. 12, Sept. 1931, pages 410-411.

Sintering methods which drive off the Pb and Cd from the Zn ores so that a purer Zn metal or oxide is obtained are briefly described. Ha (31)

Manufacture of Ferro-Silicon. Roy P. Hudson. *Blast Furnace & Steel Plant*, Vol. 19, Mar. 1931, pages 399-401.

The manufacture of ferro-Si in the blast furnace as a regular product is explained; its uses and the properties of alumina slags are briefly discussed. Ha (31)

Gas and Stock Flow in the Blast Furnace. S. P. Kinney. *Blast Furnace & Steel Plant*, Vol. 19, Mar. 1931, pages 407-411.

The distribution of gas velocities from wall to center of the blast furnace is illustrated in charts and diagrams and some of the irregularities found in blast furnace practice are discussed. Ha (31)

Dezincification of Lead Slags. (Zur Entzinkung von Bleischlacken.) Thews. *Die Metallbörse*, Vol. 21, Feb. 21, 1931, pages 339-340; Mar. 7, 1931, page 346.

The method of Pape, the Wälz process, the dezincifying in the blast furnace, the liberation of Zn by blowing compressed air into the liquid slag (Anaconda method versus German Patent 232,479) and the author's own experiments are covered. EF (31)

Reduction of Chromium Oxide and Production of Carbon-free Chromium-Iron Alloys. (Beitrag zur Reduktion des Chromoxyds und zur Darstellung kohlenstoffreier Chrom-Eisen- Legierungen.) H. H. Meyer. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, Report 187, 1931, pages 199-204; *Stahl und Eisen*, Vol. 51, Dec. 17, 1931, pages 1574-1575.

The investigation reported continues a former investigation on the reduction of MnO, SiO_2 and P_2O_5 (*Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 9, 1927, pages 273-277.) Cr_2O_3 in the absence of Fe is not reduced by hydrogen below 1600° C. Mixtures of Cr_2O_3 and carbonyl-Fe containing 0.02% C and 10-50% Cr_2O_3 were reduced by H at 1150-1400° C. The reduction begins at 1150° C.; at 1350° C. 95% reduction is attained after 11 hrs.; the alloy formed contained 13.03% Cr. An alloy containing 19.1% Cr was obtained from a mixture containing 35% Cr_2O_3 reduced for 11.5 hrs. at 1350° C. and giving 79.8%. No clear relation could be found between the amount of Cr_2O_3 in the mixture and the velocity of reduction. In spite of the variable C content of the specimens and the variable time and temperature of reduction the alloy obtained always contained 0.04-0.06% C and the reduction was not accelerated by C. For Cr plating it is necessary to use temperatures at which the Cr_2O_3 sinters; since the oxide then is not in close contact with the parts to be plated the plating is not uniform but spotty, causing an accelerated corrosion. This can be avoided if parts are plated repeatedly. Pieces of electrolytic Fe, Krupp soft Fe and a steel with 0.77% Cr were thus plated without difficulty, although there was a pronounced tendency for intercrystalline corrosion. The Herbert pendulum hardness of the Cr-plated electrolytic Fe was uniform and not much harder than electrolytic Fe. In the Krupp soft Fe, and still more in the 0.77% C steel, fluctuations of the hardness occurred due to the formation of carbides. Some spots were 145% harder. When the Cr-plated specimens are heated to 1150° C. in H and then quenched in H_2O the specimens possess, independent of the C content, a hardness which is uniform throughout the surface. This is due to the formation of martensite. The quenched Cr layer is hardly attacked by HNO_3. Lamellar pearlite occurring along the grain boundaries and near the surface of Cr-plated specimens, particularly in the electrolytic Fe, causes intercrystalline corrosion. The pearlite disappears when the specimens are annealed at 1200° to 1250° C. for 1-3 hrs. The formation of the pearlite is due to the fact that the Cr content of the outer Cr layer is so high that the γ-field is not passed, but an annealing above 1100° C. equalizes the Cr content of the Cr layer and the whole layer then passes the γ-field in cooling. Thus pearlite is not formed but a martensitic structure appears. 9 references. GN (31)

Course of the Reactions in Bosh and Hearth of Blast Furnaces and Its Meaning for the Blast Furnace Process. (Verlauf der Vorgänge in der Rast und im Gestell und ihre Bedeutung für den Hochofenprozes.) A. Mund, J. Stoecker & W. Eilender. *Stahl und Eisen*, Vol. 51, Nov. 26, 1931, pages 1449-1462.

Report 124 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. Reactions in a 500 ton blast furnace running on "steel Fe," "hematite" and foundry pig Fe were investigated. Since the bosh of the furnace is about 5 m. high and the hearth is rather narrow, 3.9 m., the furnace is equipped with a group of additional tuyères 1825 mm. above the main tuyères. About 600 samples were drawn from the 2 levels of the tuyères and from the cinder notch. A special apparatus was devised for taking samples from the center of the bosh. Part of the liquid pig Fe oxidizes in front of the tuyères, to be later reduced below the main tuyères. To effect this reduction, the accompanying elements in the pig Fe are not sufficient, for the greatest part of them are not introduced into the Fe until the hearth is reached. Reduction of some of the burden and of the burnt Fe, desulphurization and slagging of the ash of the coke is effected in the hearth. GN (31)

Particle Size of Charges in Swedish Charcoal Furnaces. (Beskickningens styckestorlek vid svenska träkolsmasugnar.) Ivar Bohm. *Jernkontorets Annaler*, Vol. 116, Jan. 1932, pages 19-38.

The percentages of material above 18.85 mm. were 67.1, 39.1, 64.8, 6.2, and 56.3 in the 5 furnaces studied; less than 1.16 mm. were 14.2, 28.4, 4.8, 36.8, and 10.0; and less than 0.074 mm. were 2.4, 6.7, 0.8, 6.6, and 1.5. Marked individual variations were noted as the charging hoppers were emptied and refilled during a run. HCD (31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Metal Finishing. *Electrician*, Vol. 107, Oct. 2, 1931, page 476.

"Bonderite" is a concentrated chemical in powder form which, when dissolved in boiling water, forms a solution that reacts quickly upon immersed iron or steel, converting the surface to a non-metallic coating that is part of the metal. Only incidental cleaning is necessary and Bonderizing is accomplished in a heated tank. 8-12 minutes' immersion in the solution is sufficient. Parkerizing is also employed at the plant of the Pyrene Co., Ltd., Great West Road, Prestford, Middlesex. WHB (32)

Acid Proofing Tanks. *Engineering & Mining Journal*, Vol. 132, Sept. 28, 1931, page 270.

The Kobbe Laboratories, Inc., N. Y. have developed a compound known as Vitrobond for proofing acid tanks. It is a S-base compound that is impervious to hot or cold acid. It has a tensile strength many times that of S, is unaffected by heat and exceptional in adhesive properties. WHB (32)

Asphalt Emulsion as Protective Coating for Metal Surfaces. *American Metal Market*, Vol. 38, Apr. 25, 1931, page 3.

The du Pont laboratory tests show asphalt emulsion having all inherent characteristics of basic asphalt or pitch, but which does not flow under heat, for use in cable and electrical apparatus trade. DTR (32)

Cleaning and Enameling Metal Surfaces. E. F. Werner. *Metal Cleaning & Finishing*, Vol. 3, Mar. 1931, pages 237-239.

A detailed outline of the cleaning and enameling process as used in the plant of a large manufacturer is given. It includes a description of the cleaning and enameling equipment. Ha (32)

Protecting Steel Pipe Lines with Thin Concrete Covering. *Engineering News-Record*, Vol. 106, May 14, 1931, page 817.

Bituminous and wrapped coverings are the usual protective measures. In certain limited sections, where alkaline and other corrosive action is pronounced, concrete, crudely applied and expensive, has given satisfaction. (32)

Modern Method of Spraying Paints and Varnishes. (Neuzeitliche Farb- und Lackspritzverfahren.) H. Reininger. *Maschinenbau*, Vol. 10, Jan. 1, 1931, pages 9-11.

The article gives a critical comparison of the spraying and dipping processes with the brush method, for coating metals. The advantages of the two former are outlined. MAB (32)

Protective Coatings for Pipe Lines. *Chemical & Metallurgical Engineering*, Vol. 38, July 1931, page 402.

A desirable coating for storage protection of pipe consists of 10% zinc chromate and 90% oil base, ¾ of which is tung oil and the remainder oils processed under heat. PRK (32)

Asphalt Coating Protects pipeline Against Texas Soil Corrosion. *National Petroleum News*, Vol. 22, Apr. 23, 1930, pages 57-58.

A 2" coating of asphalt is being used by the Houston Pipe Line Co. for protecting pipe in the swamp areas of the coastal plains region. A galvanized iron form is used in the application of the coating. VVK (32)

Unique Type Conveyor Developed for Oven Installation. *Fuels & Furnaces*, Vol. 8, Sept. 1930, pages 1263-1268; *Metal Cleaning & Finishing*, Vol. 2, Oct. 1930, pages 891-896.

Illustrated description of an installation of ovens and accessory equipment for finishing of metal furniture. Consists of wash tanks, dry-off oven, dip tanks and primer bake-oven served by a continuous conveyer which combines the desirable features of both the cross-bar and the monorail types of conveyors and also grain-coat and lacquer ovens. MS (32)

Rubber Tank Linings in Steel Pickling Operations. *Rubber Age*, Vol. 30, Oct. 10, 1931, pages 21-22.

A new principle, the Vulcalock process, embodies a new method of vulcanization, whereby soft elastic rubber can be attached directly to the surface of metals with an adhesion exceeding 500 lbs./in.^{2} It makes practically an integral union. This method eliminates the unsatisfactory service given by soft or hard rubber linings for pickling tanks through the physical damage of the former and great difference in expansion at extreme temperature changes for the latter. The hard rubber layers are, in the new process, not joined together but overlap each other and are bound together by soft rubber which absorbs the expansion and contraction and eliminates buckling and cracking. Considering that life is longer than in the case of wood, especially at temperatures above 100° F., the costs are practically the same. Ha (32)

Formation of Spots on Metal Wares Coated with Zapon Lacquer (Fleckbildung auf zaponierten Metalwaren). Freitag. *Oberflächentechnik*, Vol. 8, Oct. 20, 1931, page 217.

The brown spots marring the appearance of zaponized articles can be suppressed by adding certain collodion preparations, cyclohexanol, to the lac and using ethylglycol as a solvent. The reason for this phenomenon is not quite clear. Ha (32)

Reconditioning Lines Costs Millions. E. P. Bly (Standard Oil Co. of California). *Oil & Gas Journal*, Vol. 29, June 5, 1930, pages T-36, T-40.

2 general plans for laying out reconditioning (pipe line) plans are discussed. One is to do the work soon enough so that substantially no leaks or pipe repairing are involved and the second is to wait until "tell-tale" pit holes actually occur—and others become imminent. In the first case, long stretches of pipe have to be worked over so as to be quite sure all incipient bad spots are discovered. Much unnecessary work is done, but the average cost per ft. is, of course, lower than when pipe repairs have to be contended with. When the unconditional avoidance of pit hole leaks is essential, this method is definitely required. In case 2, where actual pit hole occurrence is the criterion for reconditioning, the work can be confined to relatively short stretches (sometimes called "hot spots") and although the cost/ft. may be considerably higher, the total annual cost may show a substantial saving. When work is confined to "hot spots," in this way it sometimes becomes most expedient and economical to follow a complete replacement schedule rather than to make repairs and apply protective coatings under the unsatisfactory conditions which frequently prevail in the field. VVK (32)

Development of Pipe Coating Machines. Dozier Finley (The Paraffine Companies, Inc., San Francisco). *Oil & Gas Journal*, Vol. 29, June 5, 1930, pages T-119, T-122.

Representative types of pipe coating machines are described. VVK (32)

Painting and Maintenance of Elevated Tanks and Standpipes. James E. Gibson, et al. *Journal American Water Works Association*, Vol. 22, Oct. 1930, pages 1330-1342.

Superintendents' Round Table discussion. Red lead with linseed oil for rust protection followed by a coat possibly of aluminum paint to protect the red lead coat mechanically is generally recommended. Litharge is sometimes added to the red lead to produce quicker drying and to increase resistance to softening. Cement-lining can also be recommended. VVK (32)

Coating for Pipes. *American Gas Journal*, Vol. 135, Nov. 1931, pages 38-39.

Report of American Gas Association subcommittee. The conclusions reached were based on a set of A.G.A. specimens of coatings buried for about 9 mos., some specimens buried by the Bureau of Standards and removed after 6 yrs. and a few specimens buried by the United Gas Improvement Co. and removed after 17 yrs. Most of the data was based upon the first set of specimens which were buried only a short while, the conclusions reached are therefore only tentative and are subject to revision. No specimens of the A.G.A. test have been removed from alkali soils. The conclusions given were: 1. Coatings which develop numerous pinholes after a short period of burial are usually thin. They show some protective value in well drained soils for a limited time but are practically useless in poorly drained soils. 2. Coatings, which show a limited number or no pinholes after a short period of burial are usually thick and offer better protection than the thin coatings. 3. Thick coatings develop pinholes principally because of the mechanical effect of the soil on the coatings where the soil has the greatest mechanical action on the coating. 4. The organic reinforcing materials are decomposed to a greater or less extent by bacteria and fungi in the soil. The extent of rotting of these materials depends upon the nature of the soil and the extent to which they are protected with bitumens or disinfectants. 5. Unvulcanized rubber appears to be unsuitable for pipe coatings because it suffers plastic flow. 6. The pinhole test appears to be the best method for determining the condition of coatings in this test. The conductance of the coating after it is dry is a rough qualitative way of measuring the condition. 7. It is difficult to determine the relative merits of pipe coatings by means of visual inspection unless the ratings describing the separate effects of the exposure of the coating are combined into a single quantity. The chief weakness of any rating scheme is the difficulty of assigning proper numerical weights or values to the several factors entering into the rating scheme. CBJ (32)

Application of Finishes on Sheet Metal with Use of the Roller Coating Machine. H. W. Parmele. *Metal Cleaning & Finishing*, Vol. 3, Jan. 1931, pages 63-68.

The principle of applying finishing materials to sheet metal with the roller coating machine is explained. It is a rapid and economical procedure as the machine can be operated at high speed and the waste of the finishing material greatly reduced. Operation of the machine, kind of finishing material to be used and the importance of cleaning the sheets prior to coating is discussed. Ha (32)

Testing and Evaluation of the Behavior of Coatings Towards Water (Prüfung und Beurteilung der Wasserfestigkeit von Anstrichen). H. Wolff. *Korrosion und Metallschutz*, Vol. 7, Aug. 1931, pages 191-195.

"Water resistivity" involves 2 properties, according to the speaker at the General Meeting of the Reichsausschuss für Metallschutz, Kiel: (1) the resistance to the permeability of water tending to corrode the metal beneath; (2) the resistance to being destroyed by the water due to soaking and swelling up. The author outlines his experiments which largely pertain to an investigation of a paraffine emulsion, called "Enkaustin." EF (32)

Crystal Lacquer—A New Metal Finisher. Ray C. Martin. *Metal Cleaning & Finishing*, Vol. 3, Apr. 1931, pages 323-324.

This is a nitrocellulose lacquer and can give crackle, stipple and similar finishes. Ha (32)

New Lacquer Developments. S. P. Wilson. *Metal Cleaning & Finishing*, Vol. 3, Jan. 1931, pages 49-52.

A general discussion of nitrocellulose lacquers and their properties. Ha (32)

Modernizing Oven Equipment Leads to Cost Reductions. Phil. Kriegel. *Iron Age*, Vol. 128, Oct. 29, 1931, pages 1108-1113.

Modern production facilities for ovens for drying and baking enameled, japanned and painted metal parts are described. Arrangement of automatic conveyors will result in continuous processing, speeding up production and reducing labor, floor space and heat requirements. The article describes specific examples. VSP + Ha (32)

Protection by Non-Metallic Coatings. (Schutz durch nichtmetallische Ueberzüge,—Farben, Lacke, usw.) W. Krumbhaar. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker*, Oct. 20, 1931, Berlin.

The paper deals with the properties and testing of protective paints, lacquers, etc., against corrosion. GN (32)

Protective Paint Coatings on Refrigerator Pipes (Schutzanstriche für Rohrleitungen von Kühlmaschinen). W. Stumm. *Gas und Wasserfach*, Vol. 74, Sept. 12, 1931, page 866.

Briefly reviews the various coatings on the market and refers to the rust-protection materials Tornesit and Herolith, recently developed by the Mannesmannröhren Werke, Düsseldorf. EF (32)

Finishing Sheet Metal. H. M. Hagy. *Metal Cleaning & Finishing*, Vol. 3, Feb. 1931, pages 145-147.

The methods of producing satin, stipple, crackle, prismatic and shrivel finishes are explained. Ha (32)

Attaching Rubber to Metal Surfaces. Morris A. Hall. *Canadian Foundryman*, Vol. 22, Nov. 1931, page 12.

A very brief description, accompanied by 1 diagram, of a method whereby rubber sheet was attached to metal. OWE (32)

CONCENTRATION (33)

Classification (33a)

Some Local Metallurgical Considerations. Andrew King. *Journal Chemical, Metallurgical & Mining Society of South Africa,* Vol. 32, Sept. 1931, pages 34-44.

Presidential address before the society. Recent experimental studies of the extraction of Au from the picking belt wastes and recent developments in tube-mill grinding are described. AHE (33a)

Flotation (33c)

Milling Methods at the Questa Concentrator of the Molybdenum Corporation of America, Questa, New Mexico. J. B. Carman. *Information Circular* No. 6551, *United States Bureau of Mines,* Jan. 1932, 14 pages.

A granodiorite ore containing 4.5-7.5% molybdenite is treated by flotation at a cost of \$2.69/ton* of ore treated (Feb. 1 - Nov. 30, 1930). Pensacola No. 100 pine oil is the collector, G. N. S. No. 5 pine oil the frother and NaCN the pyrite depressor. One pound of a mixture of 5 parts Pensacola to 1 part G. N. S. pine oil (by volume) per ton of ore is added to the ball mill and 0.08 lb. NaCN (in a 10% solution) at the secondary cleaner. In the rougher cell, heads (not including returned middlings) average 5.2% MoS_2, concentrates 30%, and tailings 0.9%; in the primary cleaner, concentrates are 55% MoS_2 and middlings 4.0%; in the secondary cleaner, concentrates are 74.5% and middlings 7.0% MoS_2; recovery in the final concentrates is 87.7% MoS_2. AHE (33c)

Concentration of Copper Ore from Arno Mines, Ltd., Coxheath, Nova Scotia. G. B. O'Malley. *Canada Department of Mines, Mines Branch, Report* No. 720, 1931, pages 82-83.

Massive chalcopyrite with pyrite in a siliceous gangue analyzed Cu 4.89-5.54%, Fe 8.63-6.16%, S 8.62%, insoluble 77.98-61.92%, Au 0.01-0.03 oz. and Ag 0.72-0.52 oz./ton. Characteristic of flotation results with various reagent combinations were recoveries of 94.4% Cu, 81% Au and 72.8% Ag in a concentrate assaying 26.4% Cu, 0.04 oz. Au and 3.44 oz. Ag per ton with soda ash 5.0 lb., NaCN 0.15 lb. and thiocarbonalide 0.1 lb./ton in the ball mill and pine oil 0.06 lb./ton in the cell. AHE (33c)

Milling Methods at the Midvale Concentrator of the U. S. Smelting, Refining and Mining Co., Midvale, Utah. R. A. Pallanch. *Information Circular* No. 6492, *United States Bureau of Mines,* Aug. 1931, 17 pages.

The main ore supply contains 10-12% galena, 12-14% sphalerite, 25-30% pyrite, and the rest gangue, principally quartzite. Flotation is used. Reagents are: Pb circuit, (1) Zn depression—Na_2SO_3 and $ZnSO_4$, (2) Pb promotion—K xanthate, Republic 19 B oil, and cresylic acid; Zn circuit—$CuSO_4$, Republic 19 B oil, Yarmor steam-distilled pine oil, K xanthate and hardwood creosote; pyrite circuit—fused Na_2S. AHE (33c)

Electricity in the New Flotation Plant. H. B. Tinling (Tinling & Rowell). *Electrical West,* Vol. 67, Dec. 1, 1931, pages 298-300.

Electrical equipment installed in the flotation plant of the Jack Waite Mining Co. at Duthie, Idaho, is described. MS (33c)

Amulet Flotation Mill Practice. W. G. Hubler. *Canadian Mining & Metallurgy Bulletin* No. 226, Feb. 1931, pages 295-306; *Bulletin* No. 234, Oct. 1931, pages 1216-1219.

A detailed description is given of the flow sheet used at the Amulet mill, Canada, for the treatment of an ore assaying Au 0.02 oz., Ag. 3.5 oz., Cu 3.5%, Zn 13%, Fe 20%, and insoluble 36%. By flotation, a 24% Cu concentrate with a 92% recovery, a 52% Zn concentrate with an 80% recovery, and 75% recovery of Au and Ag were obtained. In the grinding circuit 0.5-0.8 lb. lime, 0.05-0.06 lb. cyanide, 0.05-0.07 lb. thiocarbonalide, 0.06 lb. Na_2S and 0.10 lb. pine oil were added per ton of total mill feed. To the Cu circuit, 0.03-0.08 lb. Na ethyl xanthate is added. The Cu tailings go to the Zn flotation circuit; Zn is floated using 1.3 lb. $CuSO_4$, 0.36 lb. water-gas-tar, 1.5 lb. lime, 0.08 lb. cyanide, 0.05 lb. pine oil and 0.06-0.10 lb. Na xanthate. AHE (33c)

Changing Over from Acid to Alkaline Circuit in Flotation Practice at the Mill of the Zinc Corporation, Limited, Broken Hill, New South Wales, Australia. Ralph D. Nevett. *Proceedings Australasian Institute of Mining and Metallurgy* No. 79, Sept. 30, 1930, pages 343-353; No. 80, Dec. 31, 1930, pages 445-460.

The Zn Corp. ore consists mainly of galena, marmatite, calcite and quartz with smaller quantities of pyrite, fluorspar and rhodonite. Aerocyanide is added to the slime feed at the conditioner and after 6 minutes run to No. 2 flotation cell where Vallo C oil and K xanthate are added. Float from cells 7-11 is returned to cell 1. The finished Pb concentrate is taken from cells 1-6. At cell 12 eucalyptus oil and K xanthate are added. The float from cells 12-14, which is too rich in Zn to return to cell 1, is run to a Wilfley table where a high-grade Pb concentrate is made. The bulk concentrate for the first number assayed Pb 75.7 and Zn 3.6%; tailings assayed Pb 0.9 and Zn 11%. Flotation tailings go to a 10-cell flotation machine. $CuSO_4$, Na aerofloat and eucalyptus oil are added, and a rougher concentrate of 30-40% Zn is obtained. Final tailings assayed Pb 0.2 and Zn 0.8%. The concentrate and Wilfley table tailings (reground and deleaded) are conditioned with CaO, fed to cell 4 with $CuSO_4$, Na aerofloat and eucalyptus oil, the float from cells 4-12 is returned to cell 1, and a Zn concentrate drawn from cells 1-3. The concentrate assayed Zn 51, Fe 8.9, Pb 2.1 and insolubles 1.7% with tailings assaying 1.2% Zn. AHE (33c)

Some Aspects of Ore Dressing. A. L. Engel. *Mining & Metallurgy,* Vol. 12, Oct. 1931, pages 447-449.

General observations on the conduct of daily operations in the plant, flotation process, air control, testing and main- Ha (33c)

Milling Methods and Costs at the Superior Concentrator of the Engels Copper Mining Co., Plumas County, Calif. V. I. Nelson. Information Circular No. 6550, *United States Bureau of Mines,* Jan. 1932, 22 pages.

A chalcopyrite-bornite ore (3:2), averaging 1.524% Cu, 0.345 oz. Ag and \$0.11 Au in 1929, is treated in 3 Minerals Separation flotation machines which produce finished concentrates (29.18% Cu), 3 middling products of different grades (13.42, 3.13 and 1.92% Cu, respectively) and tailings (0.16% Cu). The middlings are retreated in pneumatic-type flotation machines. The richest middling (cells 2-4) goes to a finisher cell and gives a concentrate (27.00% Cu) and a tailing (12.18% Cu) which with middling 2 (3.13% Cu) (cells 5-7) goes to a primary cleaner. The concentrate from the primary cleaner (19.98% Cu) goes to the finisher cell with the rich middling, while the tailings (3.37% Cu) plus the lean middlings (cells 8-12) make the feed to a secondary cleaner. The concentrates from the secondary cleaner (11.22% Cu) are fed to the primary cleaner and the tailings (1.96% Cu) return to the head of the circuit. The M.S. tailings (0.16% Cu) are concentrated in scavenger cells to give a product (1.05% Cu) for return to the head of the circuit and a final waste (0.15% Cu). Cu recovery is 91.34% at a total cost of \$0.6521 per ton of ore (1929) divided as follows (cents): breaking 8.56, crushing 2.75, primary grinding 15.28, secondary grinding 9.38, classifying, screening and conveying 3.86, flotation 9.32, dewatering and handling concentrates 3.29, assaying and sampling 1.17, tailings disposal 5.83, water 0.14 and miscellaneous 5.63. Reagent consumption (lbs./ton) in 1929 was lime 0.1806, xanthate 0.0787, fuel oil 0.1045, M.S. No. 14 pine oil 0.1571 and Risor pine oil 0.0485; or Na_3PO_4 0.0600, xanthate 0.0753, fuel oil 0.2402, M.S. No. 14 pine oil 0.1788, and Risor pine oil 0.0504. AHE (33c)

All-Flotation at North Broken Hill, Limited. Alfred Lowry. *Proceedings Australasian Institute of Mining and Metallurgy* No. 79, Sept. 30, 1930, pages 355-377; No. 82, June 30, 1931, pages 101-113.

The pulp after grinding is classified into fines and granular ore. The latter is diluted with alkaline H_2O to approximately 2 parts H_2O to 1 of solids (by weight) and maintained at approximately 0.005% Na_2CO_3 strength. The following reagents are added before flotation: eucalyptus oil-coal tar 0.038, K xanthate 0.019, Na silicate 0.058 and Na_2CO_3 0.509 lb. per ton of ore. Flotation of galena is almost instantaneous. Tailings from the first 8 cells are retreated with eucalyptus oil-coal tar 0.008, K xanthate 0.003 and Na_2CO_3 0.073 lb. per ton. The fines produce a similar Pb concentrate. A Zn concentrate is produced from tailings in both the coarse and fine circuit. Analysis of crude ore for June, 1930, was Pb 14.03, Zn 10.53, Fe 5.06, Mn 0.77, Cu 0.10, $Al_2O_3$0.53, CaO 1.20, S 9.77, insolubles 57.26, CO_2 0.50, undetermined 0.25% and Ag 8.3 oz. per ton. Pb concentrate (18.1% of feed) assayed Pb 70.0 Zn 5.7% and Ag 39.8 oz. per ton, and accounted for 94.1% of the Pb, 86.5% of the Ag and 10.1% of the Zn. Zn concentrate (17.0% of feed) assayed Pb 2.0, Zn 50.3%, Ag 2.8 oz. per ton and accounted for 2.5% of the Pb, 5.7% of the Ag and 83.6% of the Zn. Tailings (64.9% of the feed) assayed Pb 0.7, Zn 1.0% and Ag 1.0 oz. AHE (33c)

Magnetic Separation (33d)

Plant for Magnetizing and Concentrating Iron Ore. H. Sundholm. *Iron & Coal Trade Reviews,* Vol. 124, Jan. 1, 1932, pages 4-5.

A method is described for concentrating weakly-magnetic ores poor in Fe. The non-magnetic Fe oxide in these ores, heated in a special manner for a short time at a comparatively low temperature, is transformed into a highly ferromagnetic modification of Fe oxide. Among the ores amenable to this process are dogger-ore, limonite, and oolitic Fe ore. Working schedule and results of the treatment are described in diagrams and tables. Ha (33d)

Crushing (33e)

The Economics of the Preparation of Iron Ores. R. Sharp. *Iron & Steel Industry & British Foundryman,* Vol. 5, Dec. 1931, pages 103-104.

A simple discussion of the crushing, calcination, agglomeration, sintering, and briquetting of ores emphasizing the fact that the production of cheap pig Fe is the ultimate desire. CHL (33e)

The Absorption of Gold in Tube Mills. H. A. White. *Journal of the Chemical, Metallurgical & Mining Society of South Africa,* Vol. 31, Dec. 1930, pages 161-171; May, 1931, pages 294-298; Vol. 32, Aug. 1931, page 31.

Though concentration upon the surface of pebbles and tube linings is a real effect, it does not account for more than a minor portion of the total Au locked up in the tube. The remainder is held in the numerous joints in the linings, between the lining and the shell and in other crevices. AHE (33e)

Explosive Shattering of Minerals as a Substitute for Crushing Preparatory to Ore Dressing. R. S. Dean & John Gross. Report of Investigations No. 3118, *United States Bureau of Mines,* Feb. 1932, 5 pages.

Minerals contain enough cracks, cleavage planes and pores to permit effective shattering through expansion of expandable substances introduced into the pores. The bulk of the experiments reported made use of the expansive power of H_2O when suddenly released from pressures at a temperature sufficiently high to convert the H_2O to steam. Using 4 to 6 mesh quartz, maximum crushing was obtained by release from 150 lbs. pressure, using 50 cc. H_2O to 100 g. quartz, and after 4 days soaking. Experiments on ores indicate a differential crushing. Thermal considerations indicate a fuel cost of 5 cents per ton of ore, figuring coal at \$2 per ton and burning efficiency of 30%. AHE (33e)

MANUFACTURERS' LITERATURE REVIEWS

339 **Matrix Alloy**—The Cerro de Pasco Copper Corporation, 44 Wall St., New York, is distributing a 31 page pamphlet showing the application of Matrix Alloys, containing 48% Bi, 28½% Pb, 14½% Sn, 9% Sb, for mounting dies. The alloy freezes at 248° F. and has a tensile strength of 13,000 lbs./in.[2] Many illustrations show its use in anchoring dies for blanking, piercing, forming, drawing, etc. Where other methods are as simple or more applicable, the fact is frankly stated.

340 **X-Rays in Industry**—This 60-page booklet, prepared by the Eastman Kodak Co., Rochester, N. Y., suggests some of the industrial applications of X-rays in inspecting the internal construction of opaque materials. It states briefly how X-rays are produced, describes the necessary apparatus and gives some rules for the proper exposure and manipulation of radiographic films.

341 **Acid-Proof Tank Construction**—The U. S. Stoneware Co., Akron, Ohio, is sending out reprints of an article which appeared in *Industrial & Engineering Chemistry* entitled "Quick-Setting Silicate of Soda Cements for Acid-Proof Tank and Tower Construction." Details of representative types of acid-proof lining construction are given.

342 **Nevastain RA**—An attractive 20-page booklet sent out by the Associated Alloy Steel Co., Cleveland, Ohio, is devoted to their new stainless steel alloy containing chromium, copper, silicon and iron. A large part of the booklet is given to a discussion of its fabrication and applications.

343 **Luxit**—The Alpha-Lux Co. Inc., 192 Front St., New York, has issued a leaflet describing their "Luxit" for lining gas or oil fired crucible furnaces, for patching cupola linings and for lining ladles. The same company has also prepared several folders describing their "Liquitol A" for steel and "Liquitol B" for iron which are said to reduce cavities and porosities in castings and will not affect physical or analytical properties of steel.

344 **Buyers' Guide**—The International Nickel Co., 67 Wall St., New York, has issued the 1932 edition of their directory of manufacturers, fabricators and distributors of structural grades of nickel steels, corrosion-resistant steels, heat-resistant nickel-chrome-iron alloys and special ferro-nickel alloys.

345 **Metallic Zinc Powder**—Paints containing Metallic Zinc Powder have certain advantages over other paints for priming and finishing iron and steel, for galvanized metal and sheet zinc. They are discussed in a pamphlet distributed by the New Jersey Zinc Co., New York. Another interesting booklet prepared by the same company is entitled "The Light Reflection Value of Color in Paint."

347 **Furnaces**—The W. S. Rockwell Company, 50 Church Street, N. Y., has just issued three bulletins devoted to their various types of furnaces. No. 327 discusses their rotary carburizing furnaces both electric and fuel, No. 328 describes their rotary heat-treating furnaces for ferrous and nonferrous metals and No. 330 is devoted to their general industrial furnaces.

348 **Corrosion Resistance**—Bulletin 1506, sent out by the American Instrument Co., Washington, D. C., discusses the U. S. Navy method salt-spray equipment for determination of corrosion resistance and its value to producers and consumers of ferrous alloys.

349 **Boiler Water Level Recorders**—Bulletin No. 112, published by the Bailey Meter Co., Cleveland, Ohio, outlines the mechanical construction and various methods of installation of their boiler water level recorder. It describes the method for obtaining records of the true water level throughout the full range of the drum. The bulletin is fully illustrated.

350 **Painting Galvanized Iron**—An attractive booklet of this name has been prepared by the New Jersey Zinc Co., New York, N. Y. Complete instructions for painting both new and weathered galvanized iron and sheet zinc surfaces are given.

351 **Industrial Furnaces**—Catalog 105 of the Chicago Flexible Shaft Co., Chicago, Ill., shows a few representative types of the Stewart industrial furnaces. These furnaces are supplied to meet every requirement in the industrial field.

352 **Industrial Application of the X-Ray**—Bulletin No. 284 of the General Electric X-Ray Corp., Chicago, Ill., is a fully illustrated 36-page booklet containing several extracts from literature in the field of industrial science and a series of specific cases of the application of X-rays in industrial work.

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353 **Rolls**—Bulletin R-1001 of the United Engineering & Foundry Co., Pittsburgh, Pa., lists their rolls for every class of rolling mill work, hot and cold, ferrous and non-ferrous, for the largest and smallest mills and auxiliary equipment.

354 **Reference Book on Stampings**—The Geometric Stampings Co., Cleveland, Ohio, has published a 28-page booklet illustrated with charts, graphs and tables which will be useful to those using stampings, forgings and castings. Although the price is $1.00, a copy will be sent free to anyone writing for it on the firm's stationery and mentioning *Metals & Alloys*.

355 **Monel Metal Bolts**—Bulletin T-1 of the International Nickel Co., Inc., New York, N. Y., gives an outline of the properties of Monel metal bolts, describing the types available and discussing their impact and fatigue strength, and corrosion resistance.

356 **Plastic Fire Brick**—Quigley "Chromix" is a chemically neutral, plastic refractory. It is adapted for construction of monolithic furnace hearths and walls; for molding burner blocks and other special shapes and for quick, durable "rammed in" refractory repairs. A booklet describing it has been issued by the Quigley Co., New York, N. Y.

357 **Heat and Acid Resisting Castings**—Bulletin No. 21 of the Standard Alloy Company, 1679 Collamer Road, Cleveland, Ohio, lists the most popular analyses of Standard-Alloy together with safe workable loads at different temperatures. The figures derived are from long time duration from field results and tests, allowance having been made for creep.

358 **Supersensitive Relay**—A leaflet sent out by the American Instrument Co., Washington, D. C., describes their new supersensitive relay which will break 1320 watts with 4 milliamperes at six volts. In spite of extreme sensitivity, this new relay is ruggedly built and may be mounted in any position. No covers or special bases are required for these instruments.

359 **Diamite**—A leaflet describing this alloy white iron has been issued by the Weatherly Foundry & Mfg. Co., Weatherly, Pa. It is extremely hard and is said to have equalled the life of manganese steel castings under some conditions at a greatly reduced cost. Test data for the alloy are given and a list of suggested uses.

360 **Circle "L"**—Two folders sent out by the Lebanon Steel Foundry, Lebanon, Pa., are devoted to their alloy steels for high stresses and wear resistance, and their stainless steel alloys for corrosion resistance and heat resistance. An analysis of each alloy is given, together with a short description of its properties and suggested uses.

361 **Furnaces** — The Surface Combustion Corp., Toledo, Ohio, has issued two folders, one telling about their continuous liquid heat treating furnace and the other describing an installation of their continuous gas carburizing furnaces at the Chrysler plant.

362 **Weld Inspection by X-Ray**—The Claud S. Gordon Co., Chicago, Ill., has prepared a folder showing the results of X-ray examination of welds. Their laboratories are equipped to X-ray any industrial materials and all shapes and sizes of steel and other metals.

363 **Welded Truck Bodies** — The feature article of the April issue of *Oxy-Acetylene Tips*, published by the Linde Air Products Co., New York, N. Y., discusses the possibility of increasing the pay load of trucks by welding the bodies. Another article in the same issue is entitled "Salvage by Cutting."

GENERAL (0)

The Gas Industry's Research Program in Metallurgy. Eugene D. Milener (Industrial Research Representative, American Gas Association). *American Gas Association Monthly,* Vol. 13, Jan. 1931, pages 15-19.

Includes forging, bright annealing, decarburization during heat treatment and brass melting. The work on forging covers burning, overheating, scaling, decarburization and rates of heat penetration. These theoretical aspects being carried on by Department of Engineering Research of University of Michigan, with results to appear as technical papers principally before A. S. S. T. Work being conducted by W. E. Jominy. Practical phases of forging being worked out by Surface Combustion Corporation. Details the development of "Diffusion Flame Gas Forge," in which radiant energy from the flame penetrates a blanket of gas which surrounds steel billets and protects from scaling and decarburization. The work on bright annealing is summarized as follows: (1) Research in the laboratory has established the requirements which must be met to effectively bright anneal brass. (2) A process has been developed known as the "methanol" process. (3) A furnace has been developed on a scale adequate to demonstrate. (4) Brass shapes have been bright annealed in this furnace. (5) The working qualities of brass so annealed have yet to be fully demonstrated. (6) The cost must be determined. (7) Process is applicable to nickel silver. (8) Use of propane is now being studied. (9) Strand annealing of copper wire by use of propane has been successfully demonstrated. (10) Control mechanisms are being developed. (11) Strand annealing by this process permits the combining of annealing with tinning into one operation. (12) Same process is used for steel strip. Brass melting is being studied at present. Other projects are short cycle malleableizing, materials suitable for immersion gas burner tubes for zinc base die casting and galvanizing furnaces. RJC (0)

The Romance of Metals & Alloys. Z. Jeffries. *Conference on Metals & Alloys, Case School of Applied Science,* Cleveland, Ohio, Nov. 1931, Paper No. 6, 4 pages. Reprint from *Cleveland Engineering,* Vol. 24, No. 25.

The development of metals in the use of mankind is described: at first, iron and copper by primitive man; gold as a precious metal was a main factor of conquest and discovery; then the artificial production of iron, steel, brasses, bronzes. Modern civilization is extensively built around steel; the electrical industry, around copper; aircraft industry around aluminum. About 5000 different varieties of metals and alloys are being used today. The scientific study of properties and the methods applied are treated briefly. See editorial comment, *Metals & Alloys,* Vol. 3, Feb. 1932, page 28. HWG+Ha (0)

Tool Steel from the Consumer's Standpoint. H. G. Keshian (Chase Companies.) *American Society for Steel Treating, Preprint* No. 37, 1931, 8 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The author presents the idea that the tool designer should have more data on the quality of his materials on which to base his design. Producer classification is urged. See also *Metals & Alloys,* Vol. 2, Oct. 1931, page 203. WLC (0)

Patent Law. F. H. Rhodes. McGraw-Hill Book Co., New York, 1931. Cloth, 6 x 9½ inches, 207 pages. Price $2.50.

If one wants to know technical facts, but doesn't know the technical jargon in which they are ordinarily couched, one must get someone to translate them. A professor of German literature is not so good a translator of a metallurgical treatise as is a metallurgist who knows the facts that the author is discussing, even though his German is meager. If the metallurgist goes to the professor to clear up any grammatical details that elude him, the final result is wholly satisfactory.

In this book, the professor's role is reversed from that of our example. A professor of chemistry has gone into the very technical subject of patent law, and produced a book that gives the facts free from legal verbiage, or at least, with the verbiage relegated to the footnotes. He has called upon patent lawyers for assistance, and has taken counsel especially with one lawyer who himself has had chemical training, but he has written the book from the point of view not of the lawyer, but of the chemist, engineer or business man who wants to know how patent law may affect him, but doesn't want to take the time to become a patent lawyer himself to find out.

There are other books on the subject that give about the same information, but we have seen none that give it in so relatively painless a fashion. It is a readable book, because it is written from the right point of view. That it is not designed to be, and would probably not be acceptable to patent lawyers as a legal text book, should commend it to a wide group of readers.

While the reviewer finds nothing in the book to lessen the doubt he has whether our patent system is a national asset—the author clearly points out how the system may lend itself to chicanery and to abuse—yet, since the system is with us, it is often necessary to know how it works. The book discusses invention, discovery, utility, novelty, priority, abandonment, details in making and prosecuting an application, rights conferred, infringement, validity, rights of employers and employees, and gives some suggestions as to patent policy, i.e., what one might well seek to cover by patent, how to license, etc.

We should have liked to have had included a discussion as to whether inventions by Government employees are the property of the individual or of the public.

We were interested to learn that the first English patent was granted by Edward III for a "composition of matter," a philosopher's stone for transmuting base metals into gold. There have been later metallurgical patents that added just about the same amount to the store of human information as the first one. H. W. Gillett (0) -B-

The Fabrication of Plant in Acid-Resisting Steels. C. Cyril Hall (Thos. Firth & Sons, Ltd., Sheffield). *Sheet Metal Industries,* Vol. 4, Jan. 1931, pages 788-798; Feb. 1931, page 883.

Paper before the Institution of Welding Engineers. Part I. The author discusses all the forming processes as applied to steels of the composition 18% Cr, 8% Ni. He recommends practice for machining, shearing, drilling, milling, cold-forming, hot-working, riveting, and welding. Gas and electric welding systems are discussed in rather great detail and the use of electric welding is favored. Part II. Heat treatment after welding is recommended to eliminate stresses and to remove the effect of the precipitation from solid solution of carbides as a result of temperatures between 500° and 900° C. A pickling bath for removal of scale has the following composition:

Water	50	parts by volume
HCl	50	parts by volume
HNO_3	5	parts by volume
Restrainer	0.25	parts by volume

Operating temperatures between 50° and 60° C. are recommended with an immersion period of 15 mins. to be followed by washing and scrubbing. Soft and hard-soldering methods are discussed. AWM (0)

Value of Specifications in the Manufacture of Steel. J. Brunner. *Proceedings American Society for Testing Materials,* Vol. 31, Part 2, 1931, pages 959-962; *Commercial Standards Monthly,* Vol. 8, Nov. 1931, pages 145-146.

See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 1. HWG+WAT (0)

Metallurgical Advances (Metallurgische Fortschritte). C. Commentz. *Umschau,* Vol. 35, Aug. 22, 1931, pages 669-670.

Replacement of Pt by cheaper alloys, corrosion resistant alloys for steam turbines, Be-alloys for aircraft construction, corrosion-proof cast iron. EF (0)

Stabilising Metals by Magnetism. Edward G. Herbert. *Metallurgia,* Vol. 5, Nov. 1931, pages 13-16, 25.

Previous work by the author has shown that, subsequent to rotation in a magnetic field, hardened steel and other materials undergo periodic fluctuations in hardness. It is now reported that the hardness can be stabilized at a high or a low value by subjecting the specimen to a stationary magnetic field. The stationary field first decreases the hardness, after which the hardness rises to an appreciably higher value which is apparently permanent. The effects of demagnetizing on the magnetically treated specimens was studied and it was found that the increased hardness was not dependent on the magnetism. In some cases the hardness of the demagnetized specimens increased while that of the magnetized ones remained constant. JLG (0)

The Organization of the Quality Production in Vereinigte Stahlwerke. (Die Organisation der Qualitäts-Wirtschaft in der Vereinigte Stahlwerke Aktiengesellschaft.) Karl Daeves & E. H. Schulz. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund,* Sonderheft 1, 1931, pages 1-16.

It is shown how the frequency curve of a certain occurrence can be used as excellent characteristic for the quality of a product. The application of this statistical method to the manufacture of a certain product from raw material to finished product is explained in all details and influences on purchasing, operation, testing, handling and research work. How such a program works out is shown on the concrete examples of a Cu addition to steel to increase the corrosion resistance which had to be verified. Ha (0)

The Application of Industrial Research. H. C. Dews. *Foundry Trade Journal,* Vol. 45, Sept. 24, 1931, pages 189-192.

After discussing the expenditures of the United States and German governments on research work, the author emphasizes the need for some active interest in research work in Great Britain. He supports his contention by quotations from various reports. A discussion follows of the manner in which the various research associations came into being. The question of applying the results of research work carried out by these associations is dealt with. Some space is devoted to the author's view of the best type of ideal development officer. The paper is followed by a discussion. OWE (0)

The Nature of the Metallic State. (Die Natur des metallischen Zustandes.) A. Eucken. *Zeitschrift für Metallkunde,* Vol. 23, Nov. 1931, pages 293-296; Dec. pages 329-334.

A discussion of the metallic state from the standpoint of modern atomic and molecular physics. RFM (0)

A Metallurgical Detective Story. *Metal Progress,* Vol. 19, June 1931, pages 94-98.

Metallographic evidence is made to solve an infernal machine murder. WLC (0)

Recent Developments in Iron and Steel. J. W. Donaldson. *Metallurgia,* Vol. 5, Dec. 1931, pages 51-52.

Includes brief discussion of methods of production and new alloys. JLG (0)

Specifications from the Standpoint of a Large Purchaser of Engineering and Special Materials. J. W. Bancker. *Proceedings American Society for Testing Materials,* Vol. 31, Part 2, 1931, pages 987-995.

See abstract of preprint, *Metals & Alloys,* Vol. 3, Jan. 1932, page MA1. HWG (0)

Where Are We Going With the New Materials? George S. Brady. *Product Engineering,* Vol. 3, Jan. 1932, pages 22-24.

The developments of 1931, particularly in stainless steels, light alloys in the use of transportation, and of cast iron are reviewed. More standardization and classification of alloys is considered desirable. Ha (0)

Metallurgy of Alloying. A. A. Bates. *Conference on Metals & Alloys, Case School of Applied Science,* Cleveland, Ohio, Paper No. 1, Nov. 1931. Mimeographed, 6 pages.

General discussion, as opening paper of the conference. The properties of an alloy bear no simple or predictable relationship to the properties of the component metals. When 2 or more metals are alloyed together, the result is usually a surprise. Hence, the complexity and importance of metallurgy. Brief comment is given on mechanical mixtures, solid solutions, intermetallic compounds, slip interference, etc. HWG (0)

PROPERTIES OF METALS (1)

Solution of Metals in Non-Metallic Solutions: Some of Their Physical and Chemical Properties. CHARLES A. KRAUS. (Brown Univ.) *Journal of the Franklin Institute,* Vol. 212, Nov. 1931, pages 537-562.

Presented at meeting of Franklin Institute, Jan. 15, 1931. The present view generally accepted is that characteristic properties of metals are due to presence of electrons which are free to move within the body of the metal, although subject to certain restrictions. Positive constituent of a metal has no metallic properties, the negative constituent, only, imparts to a metal those properties that we call metallic. Alkali and alkaline earth metals dissolve in liquid ammonia with the formation of ions. Positive ions are normal ions of these metals, while negative ions are electrons. Physical and chemical properties of these solutions are in accord with this view. Metallic compounds, when they dissolve in liquid ammonia, form ions of the normal type; the more electronegative element forms the anions. The metallic condition of matter is restricted to matter in a highly condensed state. If the atoms are separated, whether in solution or as a vapor, the metallic properties disappear. In an ionizing medium, however, the electron retains certain of the properties that it possesses in elementary metals. DTR (1)

The Magnetic Susceptibility of Iron at Temperatures Slightly Above the Curie Point. (Susceptibilité magnétique du fer a quelques degrés audessus du point de Curie.) L. NÉEL. *Comptes Rendus,* Vol. 194, Jan. 18, 1932, pages 263-265.

The author reports the results of a study of the magnetic properties of Fe at temperatures immediately above the Curie point, over which small range the susceptibility does not obey the Weiss law. The article is accompanied by 1 table and 1 diagram, which give details of the results of his experiments. OWE (1)

The Nature of Metals in Relation to their Properties. EARLE E. SCHUMACHER. *Scientific Monthly.* Vol. 34, Jan. 1932, pages 22-30.

The nature of metals and the meaning of hardness is explained by the lattice structure and the planes in them determined by the position of the atoms. Sliding or slipping may take place between these planes, and on the resistance to this sliding depends the hardness of the metal. This is explained and illustrated by several photomicrographs of lead showing various stages of hardening. Until all properties of the structural elements are known the behavior of metals can not be completely understood. Ha (1)

Presence of Electro-Motive Forces in Short-Circuited Metallic Circuits of Uniform Temperature (Existenz elektromotorischer Kräfte in geschlossenen metallischen Stromkreisen von gleichmässiger Temperatur). O. SCARPA (Royal Polytechnikam of Milano). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 154, Sept. 1931, pages 225-226.

The occurrence of e.m.f.'s could be detected in circuits consisting of metallic conductors at uniform temperatures if the metals in contact are forming solid solutions or intermetallic compounds. The short-circuited chains investigated were composed as follows: Cu/Hg (Me) Cu, wherein Me = Zn, Cd, Ag, Au, Pb, Bi, Ni, Fe, Al. Volta's law of electromotive series and some further thermo-electric laws only hold true if the metals in touch with each other are indifferent to each other. Critical comment on a recent publication of K. Schwarz is included (*Zeitschrift für physikalische Chemie,* Abt. A, Vol. 154, Apr. 1931, pages 245-254).

Cadmium. FRED GROVE-PALMER. *Metal Industry,* London, Vol. 39, Aug. 28, 1931, pages 195-196, 206.

Brief mention is made of the preparation of pure cadmium and of electroplating steel with cadmium for rust proofing purposes. PRK (1)

The Appearances of the Forbidden Lines and the Intensity Modifications of the Spectra of Mercury, Cadmium and Zinc Under High Frequency Excitation. J. OKUBO & E. MATUYAMA. *Physical Review,* Vol. 38, Nov. 1931, pages 1651-1655.

With an oscillator of a frequency of 3×10^3 cycles/sec. the intensity modifications of the spectra of Hg, Cd and Zn were studied. The singlet series and the intercombination lines which begin on the singlet levels were straightened as has been observed by previous investigators in the case of Hg and the results were extended to the case of Cd and Zn. The intensity relations of the forbidden line $1S - 2p_1$ of Hg were studied under this condition of excitation and also $1S - 2p_{1,3}$ of Cd were observed. The relation between the lines and the bands are discussed. Some consideration is also given to the conditions of excitation from the intensity modifications of lines. WAT (1)

Magnetization and Thermal E. M. F.'s. S. R. WILLIAMS. *Physical Review,* Vol. 38, Jan. 1932, page 368.

The paper is one of those presented in a Symposium on Magnetization by the American Physical Society, Sept. 1931. The thermal e.m.f. developed between transversely and longitudinally magnetized wires is shown for Ni and Fe. The experiments show that temperatures determined by thermocouples in magnetic fields are not reliable unless the elements of the couple are unaffected by the field. A number of elements are displaced in the thermo-electric series by being in a magnetic field. WAT (1)

Some New Experimental Methods in Ferromagnetism. S. L. QUIMBY. *Physical Review,* Vol. 38, Jan. 1932, pages 343-353.

A paper in the Symposium on Ferromagnetism of the American Physical Society, Sept. 1931. A brief description of certain methods which have been devised for observing the magneto-elastic, mechanical and thermal properties of single crystals of nickel, as well as polycrystalline specimens of the same material are described. Attention is directed to a special process for refining the nickel. The general procedure is similar to that developed by Bridgman for the production of single metallic crystals. The novelty of the present arrangement, however, consists in those features which permit the use of this method at a temperature of 1500° C. WAT (1)

The Specific Volume of Liquid Iron (Das spezifische Volumen von flüssigem Eisen). E. WIDAWSKI, *Stahl und Eisen,* Vol. 51, Oct. 15, 1931, pages 1290-1291.

Investigations of F. Sauerwald and his collaborators are briefly reviewed. The work at the high temperatures of molten iron necessitated the development of a special method in order to measure the density of Fe-C alloys at high temperatures. The table below gives the values obtained.

Carbon content %	Melting point ° C.	Specific Volume at melting point	Specific Volume at 1600° C.	Temperature Coefficient	Specific gravity at melting point	Specific gravity at 1600° C.
0.0	1533	0.1402	0.1405	0.05×10^{-4}	7.13	7.12
0.5	1480	0.1408	0.1411	0.06×10^{-4}	7.10	7.08
1.0	1458	0.1412	0.1417	0.06×10^{-4}	7.08	7.05
1.5	1422	0.1416	0.1425	0.07×10^{-4}	7.065	7.02
2.0	1382	0.1418	0.1432	0.07×10^{-4}	7.05	6.98
2.5	1341	0.1419	0.1438	0.08×10^{-4}	7.05	6.95
3.0	1290	0.1419	0.1445	0.08×10^{-4}	7.05	6.92
3.5	1232	0.1418	0.1452	0.09×10^{-4}	7.05	6.88
4.0	1170	0.1415	0.1459	0.10×10^{-4}	7.06	6.86
4.2	1150	0.1414	0.1462	0.10×10^{-4}	7.07	6.84

GN (1)

Frictional Electric Charges Upon the Surfaces of Single Metal Crystals. P. A. MAINSTONE. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Aug. 1931, pages 535-538.

Measurements of the frictional charges produced by very light rubbing upon the surfaces of metals under varying gas pressure did not reveal conclusively any marked differences between the tribo-electric effects upon the various faces of a single metal crystal or between polycrystalline and single crystal surfaces. Ha (1)

The Magnetization-Temperature Curves of Iron, Cobalt and Nickel. F. TYLER. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 11, Feb. 1931, supplement pages 596-602.

The theoretical significance of the spontaneous magnetization-temperature curves based on the Weiss theory is discussed, certain modifications required by quantum considerations are added. The electron spin is regarded as the fundamental magnetic element operative in the three ferromagnetic metals Fe, Co and Ni. 14 references. Ha (1)

On the Nature of the So-Called Radio Colloids (Ueber die Natur der sogenannten Radiokolloide). O. WERNER (Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem). *Zeitschrift für physikalische Chemie,* Sect. A, Vol. 156, Sept. 1931, pages 89-112.

The author endeavors to throw light upon the nature of the so-called radio-colloids by means of a photographic and and a centrifugal method and proves the phenomenon being based on adsorption in the case of radio-active lead and bismuth. Experiments on the influence of additions of electrolytes disclose the influence exerted by the charge and solubility upon the adsorption ability of the radio elements. EF (1)

The Resistance of Bismuth in Alternating Magnetic Fields. WILLIAM W. MACALPINE. *Physical Review,* Vol. 37, Mar. 1931, pages 624-633.

Apparatus for producing a field of 100 gauss r.m.s. at 10^6 cycles with a 50 watt tube is described. Also a method of measuring the behavior of bismuth wire in such a field at liquid air temperature. For this purpose a potentiometer has been developed for the measurement of the amplitude and phase of voltages at frequencies up to at least 10^6 cycles/sec. It was found that the resistance of the Bi follows the instantaneous values of the field, having a magnitude at any instant equal to what it would have if the field at that instant were maintained constant. The precision of the magnitude calculated from the various factors involved is $\pm$ 3.5% and the experimental value is normal within this precision. At 55 kilocycles and at room temperature the resistance of the Bi was also found to be normal in magnitude and phase. WAT (1)

Chemical Valency and Spectral Properties. (Chemische Valenz und die Eigenschaften der Spektraltherme.) A. T. WILLIAMS (University of La Plata) *Physikalische Zeitschrift.* Vol. 32, Nov. 15, 1931, pages 870-875, 6 references.

Data is given covering the relationship between chemical valency and spectral properties of atoms of the following elements: B, Al, Ga, In, Te, C, Si, Sn, Pb, N, P, As, Sb, Bi, O, S, Se, Te, F, Cl, Br. EF (1)

On the Resistance of Lead to High-Frequency Currents at Superconducting Temperatures. J. C. MCLENNAN, A. C. BURTON, A. PITT & J. O. WILHELM. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Sept. 1931, pages 707-719.

The resistance of Pb to steady currents becomes abruptly of vanishingly small magnitude when the temperature of 7.2° absolute is reached. This investigation was made to ascertain whether or not this abrupt change occurs for high-frequency currents of the order of 10^7 cycles/sec., also. Test methods and apparatus are described. A definite conclusion could be made: there is no discontinuity in the resistance of Pb to currents of 11×10^6 frequency when passing from above to below the superconducting point and down to 4.2° K. Pb, in the superconducting state, shows no apparent decrease in resistance below 7.2° K., but for high frequency currents a decrease for temperatures down to 4.2° K. was obtained. Ha (1)

The Electrical Conductivity of Ruthenium, Ruthenium Carbide and Tungsten Carbide. J. C. MCLENNAN, J. F. ALLEN & J. O. WILHELM. *Transactions of the Royal Society of Canada,* 3rd Series, Vol. 25, Sec. 3, May, 1931, pages 13-17.

The authors made an investigation of the electrical conductivity of ruthenium at low temperatures in 1929 and found that the material became superconducting at a temperature of 2.04° K. Subsequent work by Meissner failed to support the contention that ruthenium was superconducting even at temperatures as low as 1.13° K. The authors, as a result of the investigation referred to, have shown that the superconductivity of ruthenium examined by them in 1929 was due to the presence of tungsten carbide. The article is accompanied by 11 tables and 4 diagrams. OWE (1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Bismuth Bearing Type Metal. (Zur Kenntnis der wismuthaltingen Schriftmetalle.) E. R. Thews. *Die Metallbörse,* Vol. 21, Feb. 28, 1931, pages 388-389.

The most important Bi-bearing type metals are discussed with respect to their chemical composition, tensile strength, elongation and Brinell hardness respectively.

Influence of Pouring Temperature, Cooling and Solubility for Gases on Defects and Strength of Aluminum Castings. (Der Einfluss der Giesstemperatur, Abkühlung und Gaslöslichkeit auf Fehler und Festigkeit bei Aluminumgussstücken.) M. Barbero. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 13, 1931, pages 882.

The influences of melting and pouring temperature of light metals is shown in the following table which gives average values:

Melting Temperature °C.	Pouring Temperature °C.	Strength kg./mm.^{2}
760	630	14.5
740	640	13.1
740	660	12.7
730	680	12.2
880	680	11.8
740	700	6.8

At higher temperatures than 750° the alloy absorbs great quantities of gases from the atmosphere and combustion gases; they are, however, not all injurious, as they partly increase the fluidity or reduce shrinkage. Ha (2)

Precious Metal Alloys. R. C. Brumfield. *Transactions American Society for Steel Treating,* Vol. 19, Feb. 1932, pages 333-367.

Includes discussion. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 2. WLC (2)

Aluminum and Its Alloys in Aircraft. T. W. Bossert (Aluminum Co. of America). *Aero Digest,* Vol. 20, Jan. 1932, pages 54-55.

A brief review of the properties and applications of the 2 high strength alloys, Al-Cu-Mn-Si (25ST), and Al-Mg-Si (51ST). The difference in their properties and the reason of their high strength is outlined. Alclad 17ST is described briefly. It is also pointed out that Al bronze powder has wide application where protection against sunlight, moisture and salt water plays a part in the aircraft industry. Al pigmented paints are widely used as protective coatings for metal in those cases where corrosion is to be avoided, especially where the structure is exposed to the sunlight. WAT (2)

Some Properties of Silicon—Aluminium Bronzes. L. J. Brice. *Engineering,* Vol. 131, Apr. 10, 1931, pages 498-500.

Condensed from paper read before the Institute of Metals, London, March 12, 1931. See *Metals & Alloys,* Vol. 2, May 1931, page 94. LFM (2)

Copper-Nickel Special Alloys. (Kupfer-Nickel-Sonderlegierungen.) M. Ballay. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 13, 1931, page 882.

These alloys are used where high corrosion resistance is demanded. Three groups are formed: 25-30% Ni, 45% Ni, and 65-70% Ni, of which the 2 last are the most important; to the last belongs Monel metal. For stresses of friction and compression Sn-Cu-Ni alloys are used successfully, for instance, 54% Ni, 33% Cu, 13% Sn; the hardness increases with the Sn-content. The hardness with the same Sn content decreases if the Cu content decreases from 50 to 30%. The mechanical properties of Si-Cu-Ni alloys are produced by heat treatment at high temperatures; the same method is successfully applied for Al-Cu-Ni alloys. An alloy of 83% Cu, 15% Ni, 2% Al if quenched in water from 1000° C. has 3 times the hardness. These latter alloys are particularly resistant against corrosion of sea water. Ha (2)

Some Magnetic Alloys and Their Properties. H. H. Potter. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Aug. 1931, pages 255-264.

It is shown that the ternary system Ag-Mn-Al possesses ferro-magnetic properties with a maximum saturation intensity of about 70 units/cm.^{3} at or near the point represented by 5 atoms of Ag, one of Mn and one of Al. The alloys in this system are, therefore, less magnetic than those of the Cu-Mn-Al system (the Heusler alloys) which have a Curie point of about 360° C. and an enormous coercive force which in the most magnetic specimens is about 5000 gauss. 2 magnetic compounds are found in the binary system Mn-Sn. The first, $SnMn_4$, has a saturation intensity of about 100 units and a Curie point at 150° C. The other is probably $SnMn_2$ with a saturation of 470 units and a Curie point at about 0° C. Ha (2)

Britannia Metal. (Britannia Metall.) R. Thews. *Die Metallbörse,* Vol. 21, Mar. 14, 1931, pages 483-484; Mar. 21, 1931, page 533.

Seventy-seven complete analyses of Britannia Metals and pewters are presented and the physical properties of the most important Sb/Sn alloys are discussed and the influence exerted by Cu, Zn, Fe, Pb is considered. EF (2)

Gun Metal. (Geschützbronze.) E. R. Thews. *Die Metallbörse,* Vol. 21, Mar. 21, 1931, pages 531-532; Mar. 28, 1931, pages 579-580.

Chemical composition and physical properties are compiled in 10 tables. EF (2)

Tempered Wires, Strength Varies with Size. R. C. Jordan. (Wickwire Spencer Steel Corp.) *Metal Progress,* Vol. 21, Jan. 1932, pages 62-65.

The tensile strength of oil tempered spring wire of the same composition is found to vary according to $T = 138{,}000/\sqrt[4]{d} - 1600/d$ where d is diameters between 0.030 in. and 0.562 in. Within the practical range of hardness and ductility the ratio of the limit of proportionality to the ultimate strength and ratio of the true elastic limit range between 75 and 80% of the ultimate tensile strength. The torsional breaking stress and the torsional elastic limit are proportional to the ultimate strength in tension. WLC (2)

Brass, Bronze and Copper Alloys. W. R. Hibbard. *Paper prepared for the Conference on Metals and Alloys.* Case School of Applied Science, Cleveland, Nov. 1931, 7 pages. Mimeographed.

A detailed description is given of all the copper products of the American Brass Company, their composition, treatment, and practical uses. Ha (2)

Magnesium Alloys. L. B. Grant. *Conference on Metals & Alloys,* Case School of Applied Science, Cleveland, Ohio. Paper No. 5, Nov. 1931. Mimeographed. 2 pages.

Brief general statement as to properties and uses. The low cost per unit volume at present prices is stressed. Castings with 8% Al, 0.4% Mn may be heat-treated to 38,000 lbs./in.^{2}, 8% elongation. Wrought alloys with comparable properties are similar, but contain less Al. These have 2/3 the strength of mild steel with ¼ the weight. HWG + Ha (2)

Centrifugally Cast Monel Metal. J. E. Hurst. *Metal Industry, London,* Vol. 39, Aug. 21, 1931, pages 171-172.

The properties of Monel metal and of silicon Monel metal are given. PRK (2)

Heat-treating and Forging Some Light Alloys. W. C. Devereux (High Duty Alloys, Ltd.). *Metallurgia,* Vol. 5, Dec. 1931, pages 45-50.

Discusses properties, working and heat treatment of several Al alloys, including Duralumin, "Y" alloy and alloys developed by the Rolls Royce Co. Gives photographs and micrographs of satisfactory and unsatisfactory forgings. The desirability of carefully controlled heat treatment is emphasized. JLG (2)

Ferro-magnetic Platinum-Chromium and Iridium-Chromium Alloys. (Ueber ferro-magnetische Platin-Chrom and Iridium-Chrom Legierungen.) E. Friederich. *Zeitschrift für technische Physik,* Vol. 13, Jan. 1932, page 59.

Pt-Cr alloys with 2, 5, 10 and 15% Cr were made by sintering powder of Pt and Cr. All these alloys proved to be ferromagnetic, the 10% Cr alloy showing the strongest ferromagnetism. In determining the ferromagnetic properties of a 10.1% Cr alloy the intensity of magnetization was found to be about 15 times smaller than that of Fe, the coercive force amounted to about 65 Örsted which about corresponds to that of tungsten magnet steel. An Ir-Cr alloy with 10% Cr is also ferromagnetic. The detailed results of the investigations on the above alloys are to be given in a later paper. GN (2)

Effect of Casting Temperature and Additions of Iron on Bearing Bronze. C. E. Eggenschwiller. *Technical News Bulletin Bureau of Standards,* Jan. 1932, page 6; *Bureau of Standards Journal of Research,* Vol. 8, Jan. 1932, pages 67-77.

A study has been recently made at the Bureau of Standards on the effect of casting temperature and additions of Fe on the properties of bearing bronze material consisting of 80% Cu, 10% Sn and 10% Pb. In addition to determinations of hardness and microstructure of this leaded bronze, several test methods were employed which simulated certain phases of actual service conditions. These tests included deformation under pounding and resistance to wear, both dry and in the presence of a coolant. As bearings are usually above room temperature while in operation, a considerable number of the tests were made at elevated temperatures. In the study of 80-10-10 bronze, cast at temperatures varying from 1850° to 2120° F. it was found that as the casting temperature, the grain size, and the resistance to wear were increased the hardness decreased slightly, and a slight tendency was noted for more even Pb distribution. Casting the bronze at about 2000° F. caused a decrease in the resistance to impact or lowered the toughness, as shown by the notch test. The deformation under pounding was a minimum in specimens cast between 1900° and 2000° F. Although Fe is not usually added intentionally to leaded bronzes, small amounts are often accumulated during the process of manufacture through the use of scrapped bearings, iron stripping rods, and so on. While the Fe content is quite small in most cases, the effect of this element is generally considered harmful. In the reported investigation the Fe content, which varied from 0-1% was studied. In general, it was found that additions over 0.3% Fe were detrimental to the bronze investigated. Small additions of Fe up to 0.5% decreased the resistance to wear and increased the hardness. When the Fe content exceeded 0.3% segregation of the Pb particles occurred, the grain size was reduced, and a decrease was noted in the notch toughness. Additions of Fe up to 1% increased the resistance to pounding. WAT (2)

New Aluminum-Tungsten Alloy in Germany. *Iron Age,* Vol. 127, Jan. 8, 1931, page 218.

A new alloy of Al in which W is used is being produced commercially in Germany under the trade name of "Benit." The alloy consists of 96.91% Al, 2% Cu, 0.45% Mn and 0.27% W. It is claimed by the maker to be easily welded, forged and drawn and has high tensile strength and hardness. (2)

Antifriction Alloys (Alliages antifriction graphites, leurs applications au matérial roulant des Compagnies de Chemins de fer). *Aciers Spéciaux, Metaux et Alliages,* Vol. 6, Apr. 1931, pages 209-211.

The characteristics of Pb base and Sn base antifriction alloys are compared with those of the graphitometal "France." Graphitometal "France," for which no chemical composition is given, performs betters than other alloys. GTM (2)

Cemented Tantalum Carbide. Floyd C. Kelley (General Electric Co.). *American Society for Steel Treating, Preprint* No. 14, 1931, 9 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The author describes the preparation of tantalum carbide and various binders used in forming tools of this material. Comparative tests of tool performance of tungsten and tantalum carbides are given. WLC (2)

M.V. "C" Aluminium Silicon Alloy. L. E. Benson. *Metallurgia,* Vol. 5, Jan. 1932, pages 93-94.

The alloy is modified by a new process developed by the Metropolitan-Vickers Electrical Co. The alloy as cast has a tensile strength of about 10 tons/in.^{2} and an elongation of 10%. The properties do not vary with the size of the casting, and the castings are free from pin holes. It also has a good resistance to corrosion. JLG (2)

High-Speed Steels (Die Schnelldrehstähle). WILHELM OERTEL & ARTHUR GRUTZNER. Verlag Stahleisen m.b.H., Düsseldorf, 1931. Cloth, 6 x 7¼ inches, 223 pages. Price 12 RM.

All phases relating to the production and utilization of high-speed steel are discussed within the brief compass of this book. The arrangement of the subject matter and the relative space devoted to each phase of the subject could hardly be improved. The book was written primarily to present critically the studies and developments of high-speed steels made within the past few years, but important older work is also discussed. A gratifying feature of this book is the clear discussion of studies described in English. Much of the authors' work is of course included, but not to the exclusion of important work by other investigators.

The book begins with a short history of the development of high-speed steel, which is followed by a discussion of the various elements used in such steels, including their occurrence in nature and their binary alloys with iron. The production of high-speed steel is then described and the causes of several defects common to improperly made steel are discussed. The heat treatment of the steel is then considered in some detail. The sections of the book which are probably the most valuable, then follow; they deal with physical properties and cutting life of high-speed steels. The subject matter of these 2 sections is particularly well presented, and warrants study by anyone interested in the metallurgy of high-speed steels.

The next section discusses the cast high-speed steels and the data given there simply serves to point out that such steels are inferior to wrought steels, which is attributed to the inability to produce the desired carbide distribution in the cast material. The next section briefly considers alloys of the Stellite type and tungsten carbide cutting tools.

The final section of the book proper lists the patents for high-speed steels issued by 6 countries. The analyses covered by these patents are also given. An amusing figure in this section is one in which the number of patents granted on high-speed steel per year is plotted against the year—the curve has a pronounced peak during the war years. 20 patents being granted in one year. References are also given to patents on alloys of the Stellite type and tungsten carbide materials.

One of the most interesting parts of the book is the portion of the appendix in which the effects of various alloying elements on the cutting life of high-speed steels as determined by various investigators are tabulated.

J. L. Gregg (3)-B-

The Use of Cast Iron in the Non-Ferrous Industry. A. L. NORBURY. *Foundry Trade Journal*, Vol. 45, Dec. 24, 1931, pages 388-390; *Metal Industry*, London, Vol. 39, Dec. 18, 1931, pages 587-590.

A paper dealing largely with effects of chemical composition and microstructure on the mechanical properties of cast iron and on the relationship between composition and growth in cast iron. Special reference is made to "Silal" and to the use of this material in the manufacture of various heat-resisting parts. The article is accompanied by 13 diagrams and 1 table. PRK+OWE (3)

The Relation between Different Hardness Numbers of Cast Iron and Chill Castings. (Die Beziehung zwischen verschiedenen Härteziffern bei Gusseisen und Hartguss.) A. WALLICHS & H. SCHALLBROCH. *Maschinenbau*, Vol. 10, Jan. 1, 1931, pages 18-20.

The relationship between Rockwell hardness, Brinell hardness, Shore hardness, Duroscope hardness, drop hardness, Herbert pendulum hardness is given diagrammatically for cast iron and hard castings. MAB (3)

Recent Developments in Cast Iron. J. G. PEARCE. *Metallurgia*, Vol. 5, Jan. 1932, pages 81-82 and 92.

The developments of austenitic irons and heat-resistant irons are stressed. JLG (3)

Anti-Slipping Steel (Griffiger Stahl). P. WIESSNER. *Dinglers Polytechnisches Journal*, Vol. 346, Nov. 1931, pages 182-183.

The difficulties experienced with rolls employed in refractory industry are pointed out. The frequent failures precipitated the development of a special steel known as "Karamitstahl," the analysis of which compares as follows with the cast steel formerly used:

Karamitstahl	Traditional cast steel
0.5 - 0.7% C	0.3% C
0.7 - 0.8% Si	0.15 - 0.18% Si
1.2 - 1.6% Mn	0.6% Mn

EF (3)

The Properties of Pig Irons from Various Sources. (Roheisensorten verschiedener Herkunft.) A. WAGNER. *Giesserei-Zeitung*, Vol. 27, Aug. 1930, pages 403-412.

Chemical analysis is not an exclusive criterion of the value of pig Fe, as many varieties of the same composition exhibit different properties. The behavior of 17 types of pig Fe, such as English hematite, foundry and Swedish charcoal Fe, was investigated by melting and remelting several times in crucibles, under as constant melting conditions as possible, and examining specimens for tensile and bending strength, hardness and microstructure. The first melting resulted in materials of low tensile strength, 8.5-12 kg., and low bending strength, 18-19 kg. Repeated remelting improved the physical properties: after the 4th melting the tensile strength increased 100% without any appreciable change in composition. Numerous photomicrographs are reproduced. (3)

Values of Hardness of Castings with Different Wall Thickness. (Hartewerte von Gussstücken mit verschiedener Wandstärke.) H. UHLITZSCH. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 27, 1931, pages 892-894.

Recent investigations have shown that, especially for machine tools, the specification of a Brinell hardness of 200 is of no value whatever if no other values of strength are specified at the same time. An attempt is made to develop hardness diagrams which take into account the contents of Si and C and the dimensions of the castings. Ha (3)

Eutectic Cast Iron. F. K. NEATH. *Bulletin British Cast Iron Research Association*, Vol. 3, Oct. 1931, pages 38-41.

Based upon the argument of Osann that Fe which casts well and gives no difficulties with shrinkage and unsoundness and in the cold state represents a close-grained pearlitic structure, must be eutectic in composition, the relationship between C and Si has been investigated and it was found that a variation of 0.1% C must be compensated by a variation of 0.2% Si in the opposite direction. The thickness of a casting therefore gives definite indication what the contents of Si and C must be. Several such examples for finding the eutectic composition are given. See also "Iron Castings with Eutectic Structure," *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 31. Ha (3)

Hard Manganese Steel. The Present Status of its Production (Mangan-Hartstahl. Ueber den heutigen Stand seiner Herstellung.) K. K. VON SCHEELE. *Giesserei Zeitung*, Vol. 27, Feb. 15, 1930, pages 98-100.

After a brief reference to the method of manufacturing Mn steel, the author discusses the properties of the material and the difficulties of using it. He points out how little data is available. He doubts the comparability of published analyses. The Mn content drops considerably from the moment when the bath is ready to the end of the casting operation and, in addition, the C content rises during the reheating of the steel. (3)

Experiments to Elucidate the Question of Danger by Pressure in Cast-Iron. (Versuche zur Klärung der Frage der Druckgefahr von Gusseisen.) M. ROS & A. EICHINGER. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, page 923.

Tests were made to ascertain the behavior of cast-iron in the presence of 1, 2 and 3-axial tensional states. The structural texture determines the behavior. The results for tensile and pressure tests, tearing strength, kind of fracture, and the changes occurring in the structures at fracture are described and discussed in detail. Ha (3)

Influence of Shaping and Heat Treatment on the Properties of Steel. (Der Einfluss der Wärmebehandlung auf die Eigenschaften des Stahles.) G. SACHS. *Die Wärme*, Vol. 54, Nov. 28, 1931, pages 888-889.

A résumé of the latest investigations on the shaping and heat treatment of steel. The crystals in sheets are usually arranged in a regular manner which results in different properties along different directions. The aging phenomenon is probably intimately connected with the precipitation hardness. Residual stresses remain after hot and cold working. Internal stresses can be revealed by X-ray examination. The γ and α transformation can be suppressed by rapid cooling. The transformation into martensite takes place abruptly. A tetragonal atomic arrangement occurs in martensite which may be considered as a medium between the spatial structure of austenite and ferrite, respectively. The tetragonal crystals are arranged in a strictly regular order, i.e., in 24 different positions with reference to the austenite, thus forming the characteristic needle-like structure of martensite. Nitrogen in steel acts very similarly to carbon. EF (3)

The Heredity of Cast Iron (Beitrag zur Frage der Vererbung von Gusseisen). H. THYSSEN & E. BUFFET. *Giesserei mit Giesserei Zeitung*, Vol. 18, Nov. 6, 1931, page 866.

The view formerly held that the size of the graphite lamellae in the original pig iron influences, to a great extent, the properties of the cast iron is again confirmed. Very large graphite lamellae result in scrap. Casts of second melts show a finer grain of the lamellae. Ha (3)

Low Alloy Steel for Structures. RICHARD TULL. (Electro-Metallurgical Co.) *Metal Progress*, Vol. 21, Feb. 1932, pages 35-38.

The author describes the properties of "Cromansil," a low alloy steel for structural purposes made to the following composition limits: Cr 0.4-0.6%, Mn 1.1-1.4%, Si 0.7-0.8%, and C 0.1-0.65%. With 0.26% C this alloy steel will show 96,000 ultimate strength, 59,000 yield point with elongation of 28% in 2 in., and reduction of area 62%. This alloy welds readily. Normalizing subsequent to welding is unnecessary except in plates heavier than 1 in. with C in excess of 0.25%. Cromansil can be rolled, machined, drawn, pierced and worked generally in the same ways as C steel. WLC (3)

Some Recent Developments in Automobile Cast Iron. T. R. TWIGGER. *Foundry Trade Journal*, Vol. 45, Dec. 17, 1931, pages 375-378.

An article, accompanied by 12 diagrams and 3 tables, in which attention is paid to the improvements which have been made in cast iron of recent years, and the methods whereby these improvements have been applied to centrifugal castings. The results of heat-treating centrifugally cast iron containing 0.50% Ni and 0.20% Cr are dealt with in considerable detail. Some attention is devoted to austenitic cast iron containing 14% Ni, 7% Cu, and 2.5% Cr. Situations in which heat-treated iron has been used with satisfactory results are described. OWE (3)

On the Magnetostriction of Iron-Nickel Alloys. Y. MASIYAMA. *Kinzoku no Kenkyu*, Dec. 1931, pages 649-660 (In Japanese); *Science Reports Tohoku Imperial University*, Vol. 20, Oct. 1931, pages 574-593 (In English).

The magnetostriction of Fe-Ni alloys in different concentrations was measured for (1) volume change, (2) longitudinal length change, and (3) transverse length change. In each case an anomalous change occurred in the region of 20-35% Ni, corresponding to a mixture of α and γ solid solutions. The transverse change of length is nearly the reverse of the longitudinal change and the volume change is the differential effect of these two. The greatest volume change occurred at 30% Ni content and at the field intensity of 1050 gausses. TM+Ha (3)

The Qualities of Cast-Iron for Guide Faces of Machine Tool Beds and Means for its Production. (Die Eigenschaften des Gusseisens guter Gleitbahnen von Werkzeugmaschinenbetten und Wege zu dessen Herstellung.) RUD. MARKER. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 27, 1931, pages 901-905.

The usually required qualities of good slide faces are discussed; the most pronounced characteristic is a pearlitic, eutectic cast iron poor in Si and C. Cast-iron cast in metal (chill) molds is not suitable. Ha (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosive Measures Adopted to Prevent Water Pipe Corrosion. ROBERT SPURR WESTON. *Water Works Engineering*, Vol. 85, Feb. 10, 1932, pages 162.

Excerpts from a paper read before the American Water Works Association. Conditions rapidly improved when a lime treatment plant was operated to remove CO_2 and to raise the pH value to 8.0. CBJ (4)

A Study of Abrasion. SEIZO SAITO. *Science Reports of the Tohoku Imperial University*, Sendai, Japan, Vol. 20, Oct. 1931, pages 560-569.

The abrasion of steel due to the combined sliding and rolling action was measured in an Amsler universal wear testing machine. The method of tests is described, and it was found that for the same materials, a test piece rotating at a higher speed is less worn than one rotating at a lower speed if the contact be rolling with a slip between the contact surfaces. For 2 test pieces of different hardness, the abrasion is less if the harder sample rotates at higher speed than vice versa. If the powder produced by the abrasion is present between contact surfaces the abrasion sometimes increases as much as 100% of that where no such powder is present. The contact between rail and tire is considered in the light of the mechanism of abrasion as explained before, by assuming that the tire flange always slips on the rail. 15 references. Ha (4)

The Galvanic Behavior of a Chromium-Nickel-Iron Alloy in Sulfite Liquors. W. ANDRES WESLEY & F. L. LAQUE. *Paper Trade Journal*, Vol. 92, Apr. 2, 1931, pages 56-61.

A Cr-Ni-Fe alloy can function as cathode in galvanic couples in neutral and in acid solutions without destruction of the surface film which renders it passive in these electrolytes. Mechanical and other disturbances of the surfaces of this alloy rendered it active, at least temporarily, in which condition it behaved more nearly like Fe than like a noble metal. Fe coupled with Cr-Ni-Fe in Na_2SO_4 solution suffered just the same amount of galvanic corrosion as it did when coupled with Pt. In sulphite liquors, freshly surfaced Cr-Ni-Fe behaved erratically for a time, but always tended to become passive, to behave like a noble metal and to remain in that condition until its surface was again abraded. The behavior of couples in which a valve bronze was connected with the alloy or with Pt indicated that the corrosion process was different in tower acid from that in reclaimed acid. The test conditions were somewhat different from plant conditions in that these solutions were saturated with SO_2 at 50° and atmospheric pressure. In reclaimed acid the corrosion of valve bronze was accelerated to the same degree when it was coupled with Cr-Ni-Fe as with Pt, indicating that the corrosion process involved to a predominating extent the reaction of some depolarizing agent active in this solution. In tower acid the corrosion of valve bronze was accelerated much less by coupling it with Fe alloy than by coupling it with Pt. A similar result was obtained in pure dilute H_2SO_4 solution. The discrepancy is thought to be the result of a difference between the H overvoltages of the 2 cathode surfaces. Ha (4)

Chemical Embrittlement of Boilers. W. W. ROBINSON, JR. *Petroleum World*, Vol. 28, Feb. 1931, pages 63-67, 89, 91-93.

A series of Southern California boiler-water concentrates was subjected to analysis for total solids, NaOH, Na_2CO_3, Na_2SO_4 and pH, for the purpose of bringing out any tendency in the waters to cause embrittlement of boiler steel by the action of NaOH. Parr and Straub's ratio, Na_2SO_4 to total alkalinity as Na_2CO_3, was found to be much below the limit of safe operation. By calculating the ratio $(Na_2SO_4+Na_2CO_3)/NaOH$, that is, by recognizing Na_2CO_3 as well as Na_2SO_4, as an inhibitor of embrittlement by caustic results more in accordance with the fact that there had been no boiler failures with the water in use were obtained. When the concentration of NaOH in a water builds up to a certain level, CO_2 is reabsorbed and Na_2CO_3 is regenerated at the expense of NaOH. Hence it would be possible in some cases to control the ratio by allowing high total solids to accumulate in the water. Ha (4)

Factors Affecting the Efficiency of Cadmium Plating as a Rust Preventive. S. WERNICK. *Industrial Chemist*, Vol. 7, Sept. 1931, pages 358-361.

13 references. The function of zinc plating as a protective deposit on ferrous metal is to act as the anode of the zinc iron cell which automatically comes into action when the case metal is exposed. Doubt is expressed as to whether a cadmium deposit functions similarly as determinations of electrode potentials of cadmium and iron have variously reported anodic and cathodic relationships between these 2 metals. The factors affecting the protection attained are: (1) The nature of the base metal. In general, rolled material is to be preferred to cast, and mild steel to carbon steel. (2) The composition of the solution, and conditions of deposition. The cyanide solution is invariably used. (3) The weight of the deposit/unit area of surface. 600 mgms./dcm.,^{2} or a thickness of 0.0075 mm. is regarded as safe practice. The critical thickness, however, will vary with crystal size of the deposit. RAW (4)

Accelerated Corrosion Test, of Sprayed Molten Metal Coatings Applied on Steel, in a SO_2-CO_2-Air Atmosphere. L. PESSEL. *Proceedings American Society for Testing Materials.* Vol. 31, Pt. 2, pages 294-303, 15 figures.

A spray test of the "salt spray" type, but using water atomized by a SO_2-CO_2-air mixture, instead of brine atomized by air, was applied to a large number of metal-sprayed metallic coatings on steel. Of 23 metals and combinations of metals spray coated upon steel, all but lead were shown to give very poor results in this corrosion test. For service of the types that might be represented by the corrosion test chosen, the life of a properly applied lead coating/0.008" thick is estimated at a minimum of 2 yrs. Cadmium was worse than zinc. Steel grit blasting of steel before depositing the sprayed metal coating is preferred to sand blasting. Many of the sprayed coatings showed poor adherence. HWG (4)

Destructive Action of H_3PO_4 on Metallic Alloys. V. K. Pershke, M. P. Kapostuin & E. V. Yushmanov. *Journal Chemical Industry*, Moscow, Vol. 7, May 1, 1930, pages 875-877.

Experiments are described on the resistance of alloy cast iron and Cu alloys containing Sn, Zn, Al, Pb, Sb and Ni to the action of 84.7% H_3PO_4 at temperatures from 20°-150° C. The results are given in 3 tables. Alloys containing 78% Cu are resistant; with 63-80% Cu, they are satisfactory; but with a Cu content lower than 63%, they are not resistant to H_3PO_4. Alloys with the same Cu content and nearly equal percentages of Pb, Al and Sb show the same resistance. With the same Cu content, Ni instead of Zn and Pb, or Sn and Zn, Pb instead of Zn increases the resistance; Pb instead of Sn has no influence; Pb and Sb instead of Zn do not change the resistance of the alloy. Alloys with a high content of Pb and Zn are not resistant. Brass with a Cu content of 85-90% and Cu-Ni alloys with 80% Cu are recommended for apparatus coming in contact with concentrated H_3PO_4 at 150°. WHB (4)

The Attack of Alkaline Printing Dyes on Copper Rolls (Ueber das Angreifen der kupfernen Zeugdruckwalzen durch alkalische Drucksolen). K. Reinking & G. Bernardy (I. G. Farbenindustrie). *Melliand Textilberichte*, Vol. 12, May 1931, page 328.

Experiments were carried out with the object of throwing light on the premature failure of copper rolls used in cloth printing. EF (4)

Corrosion of Water Mains. H. R. Redington, J. L. W. Birkinbine & F. N. Speller. *Journal American Water Works Association*, Vol. 23, Nov. 1931, pages 1649-1693.

Pipe now represents from 8 to 9% of the total yearly iron and steel production, or about 11% of the finished products. Between 70 and 80 million tons of tubular products have been put into service in the last hundred years. About 75% of this amount has been made and installed in the last 20 years, and about half of this total tonnage has been used for water, oil and gas lines. The improvement in the quality of piping material has been considerably advanced by rigid specifications, covering its physical and chemical properties, its fabrication, inspection, tests, joints, coatings, etc. The theory of corrosion, its causes and preventions, are reviewed. There seems to be no question among water works engineers as to the reliability of steel, when properly protected and laid in such circumstances as the local conditions require. Protective coatings are treated in some detail, both nonmetallic and metallic. Data furnished by the Portland Cement Association indicate that properly made concrete is a practical method of defeating corrosion of both large and small pipe under very severe soil conditions. They recommend a 1-inch minimum reinforced coating made of one sand, 1½ gravel and 3 cement; and the use of 2-inch by 6-inch mesh No. 13 wire, the reinforcement being carefully placed in the center of the covering so that it will have at least one half-inch protective covering. Cement-lined and Talbot-lined pipe offer a practical means of preventing corrosion and loss of capacity due to internal incrustation or tuberculation. Talbot lining, an English development now available in this country, consists of a selected asphalt bitumen mixed with a chemically inert filler, and is applied to the inside of the pipe by the centrifugal process. The widespread adoption of industrial water softening by the Zeolite process has also completely changed the corrosion picture as regards life of pipe in the hard water districts. The manufacturers are making every effort to produce pipe material and protective coatings that will reduce the losses caused by the deteriorating effects produced by service conditions, but the great need is comparative data from many communities. WAT (4)

Corrosion Protection of Water Constructions. (Korrosionsschutz bei Wasserbauten.) A. W. Rick. *Korrosion und Metallschutz*, Vol. 7, Nov. 1931, page 278.

The author outlines the salient features of sub-aqueous protection and reviews the non-metallic coatings for preserving the surface stability of structural work under the water level. The following groups are treated separately: (1) Oil containing hard resin coatings. (2) Artificial resin lacquers and cellulose lacquers. (3) Bituminous coatings. EF (4)

Corrosion and Conservation of Underground Structures. P. J. Richards. *Journal American Water Works Association*, Vol. 23, Apr. 1931, pages 529-533.

A general discussion of soil corrosion and protection. VVK (4)

Complex Compounds of Tartaric Acid and Tri-Valent Metals (Komplexverbindungen der Weinsäure mit dreiwertigen Metallen). E. E. Wark & J. W. Wark (University of Melbourne). *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 157, Nov. 1931, pages 310-314.

Among the tri-valent metals, Fe, Cr, and Sb are considered. EF (4)

Protection of Pipes in Water Works from Frost, Ice and Other Influences. (Rohrbeschädigungen bei Wasserversorgungsanlagen durch Frost, Bergschäden und andere Einflüsse.) E. Wahl. *Das Gas- und Wasserfach*, Vol. 74, Mar. 28, 1931, pages 289-293; Apr. 4, 1931, pages 311-318.

Transmission pipes 1.5 m. underground, if not carefully installed, will cause trouble due to frost. Fractures caused by the cold can be avoided if the pipe lines are placed far enough below the surface. In two cases the depth to which the frost penetrated the ground was determined by tests and observations. In mining operations the question of the depth of the piping is important for the same reasons. Fractures in pipes caused by ice formation are characterized and classified. Losses due to frost and similar influences are discussed. Cases where tubes laid in clay or loam soil graphitized were observed. MAB (4)

Corrosion in Tanks and Tankers. *Engineering*, Vol. 131, May 15, 1931, pages 643-644.

Editorial commenting on paper read by J. Foster King and J. L. Adam before the North-East Coast Institution of Engineers and Shipbuilders. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 163. LFM (4)

Thin Films and Corrosion. Ulick R. Evans. *Engineering*, Vol. 152, Sept. 18, 1931, page 291; *Korrosion und Metallschutz*, Vol. 7, Oct. 1931, page 249; *Foundry Trade Journal*, Vol. 45, Sept. 17, 1931, pages 173-174 and 184; Sept. 24, 1931, pages 197-198.

Abstract of paper read before the Institute of Metals, Zurich, Switzerland, Sept. 1931. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 4. LFM + OWE (4)

Metallic Coatings as Protection Against Corrosion. (Die metallischen Ueberzüge als Korrosionsschutz.) W. H. Creutzfeldt. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker*, Oct. 20, 1931, Berlin.

5 methods of making metallic coatings are discussed: (1) rolling on or soldering on, (2) diffusion at high temperature, (3) dipping in the coating metal, (4) spraying on of the liquid coating metal, (5) electrolytic depositing. There follows a discussion of coatings of Zn, Sn, Cd, Pb, Al, Cu, brass, bronze, Ni and Cr. GN (4)

Peculiar Observations During the Solution of Steel in Acids. (Eigentümliche Beobachtungen bei der Auflösung von Stahl in Säuren.) K. Daeves, E. H. Schulz & R. Stenkhoff. *Stahl und Eisen*, Vol. 51, Nov. 12, 1931, pages 1397-1402; correction, Nov. 19, 1931, page 1441.

After reviewing previous observations on the above problem, the authors report the result of their own investigations which show that the time of solution of steel is rather independent of the composition as far as C, Mn, S and P are concerned, with the exception of Cu. A special apparatus has been devised to facilitate the determination of the actual time of solution. This apparatus measures the developed gas volumes and makes it possible to accurately establish the effect of the previous treatment of the steels, such as deformation, annealing and hardening, upon the time of solution. Though many factors have their bearing upon the result of the individual determinations, it could be shown that the process according to which the steel had been made has a marked effect upon the time of solution. The results indicate that the time of solution of Thomas steel is shorter than that of open hearth steel. Whereas the time of solution of 25 samples of Thomas steel made by 4 different plants is practically alike, rather heavy fluctuations were found with 25 samples of open hearth steel made by 4 different plants. GN (4)

The Causes of Corrosion Phenomena Observed Occasionally on Stationary Oil Tanks of Aluminum. (Ueber die Ursachen der an Standölkesseln aus Aluminium gelegentlich aufgetretenen Korrosionserscheinungen.) G. Eckert. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk*, Vol. 3, Sept.-Nov. 1931, pages 351-354.

Tests have shown that linseed oil, if overheated, can occasion corrosion of Al apparatus. A strict temperature supervision where linseed oil is boiled in Al vessels should therefore be exercised. Ha (4)

Fittings for Fermentation and Storage Vessels of Aluminum. (Armaturen an Aluminium-Gär -und Lagergefässen.) G. Eckert. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk*, Vol. 3, Sept.-Nov. 1931, pages 354-356.

Examples of corrosion on beer tanks, caused by mercury contact and other effects, are illustrated. A joint to the discharge pipe is recommended which eliminates the trouble. Ha (4)

The MBV-Process, an Effective Surface Protection for Aluminum and its Alloys. (Das MBV-Verfahren, ein wirksames Oberflächenschutz-Verfahren für Aluminium und dessen Legierungen.) Eckert. *Aluminium Hauszeitschrift V. A. W. und Erftwerk*, Vol. 3, Sept.-Nov. 1931, pages 349-351.

By treating Al wares in an aqueous solution of 5% calcined soda and 1.5% sodium-chromate for 3 to 5 min. at 90°-100° C. a protective film has been formed which will stand bending and rolling to a certain extent. The layer resists beer, gin, sour milk, soap solutions and other liquids used in making artificial silk. Acids and alkalis destroy the layer. Ha (4)

Influence of the Shaping and Riveting of Structural Iron on Corrosion. (Einfluss der Formgebung und Nietung von Konstruktionseisen auf die Korrosion.) V. Duffek. *Korrosion und Metallschutz*, Vol. 7, Nov. 1931, pages 275-277.

The paper presented before the Reichsausschuss für Metallschutz, May 1931, reports on corrosion experiments in tap and sea water carried out with the object of studying the relation of the corrosion attack to the shape of the samples tested and to the influence of rivets respectively. The experimental work is performed in the Duffek corrosion apparatus, which represents an accelerated corrosion testing method. (24 hours, 120 mm. constant O_2 pressure). A more pronounced corrosion attack was noticed in the regions around the rivets. A protective effect of the rolling scale, which was not removed, could be established. One set of specimens was submitted to an annealing treatment. However the resulting oxide scale did not display a marked corrosion protection as was distinctly the case with the scale produced by rolling. An increased corrosion attack was noticed when the corrosion products were not removed from the surface. In contrast with Evans' theory the author found that horizontal planes with a surface directed downwards hardly showed any corrosion attack, whereas the top surface of the horizontal areas were strongly corroded. The author connects this phenomenon with the corrosion products which inhibit the depolarization of the hydrogen. The iron absorbs the hydrogen and assumes a less noble potential which results in an accelerated solution of the metal. Based on his observations, the writer urges construction engineers to avoid horizontal areas and to provide for means for a flowing off of the corrosion products. EF (4)

Corrosion of Gas Plant Equipment. B. G. Dick. *Gas Age-Record*, Vol. 66, Sept. 20, 1930, pages 433-436, 442; *Western Gas*, Vol. 7, Aug. 1931, pages 66-73.

Part of Report of Committee on Corrosion of Gas Plant Equipment of the Pacific Coast Gas Association. Corrosion of metal roofs, gutters and downspouts, holder cups, oxide purifiers, smoke scrubbers, steel brick lined waste heat boiler flues, reciprocating pump valves and parts exposed to the atmosphere. VVK (4)

Metallography & Macrography (5a)

On the Ternary System Iron-Nickel-Phosphorus (Ueber das ternäre System Eisen-Nickel-Phosphor). R. VOGEL & H. BAUR. *Archiv für Eisenhüttenwesen,* Vol. 5, Nov. 1931, pages 269-278.

Report from the Metallographic Laboratory of the Institute of Physical-Chemistry at the University of Göttingen. 10 references. The complete ternary diagram was established for the concentration range Fe-Ni-Ni_3P-Fe_3P, i.e., for the Fe-Ni alloys containing up to 15% P, by studying the cooling conditions of 8 concentration sections. In the field of the alloys containing a higher percentage of P, the features of the equilibria between the 4 phosphides Fe_3P, Ni_3P, Ni_5P_2 and Fe_2P were determined. The results show that ternary phosphides do not exist within the concentration range examined. Fe_3P and Ni_3P form a complete range of solid solutions without miscibility gap. The Fe-rich members of these solid solutions correspond to the meteoric "Schreibersit." In the concentration range Fe_3P-Ni_3P-Ni there exists a 4-phase transitory equilibrium between melt, P and Ni bearing α-and γ-solid solutions and the solid solutions of Ni_3P and Fe_3P (Schreibersit). The equilibrium temperature is 970° C. Between the above 3 crystal phases exists a ternary miscibility gap. The transformations of the ternary Fe-P-Ni solid solutions are of a very complicated nature, due to the following reasons: (1) The changes of solubility are of a peculiar nature because of the recurrence of the α-γ-transformation in the system Fe-P; that means the alignment of the γ-field in connection with the widening of the γ-field in the system Fe-Ni, which occurrences totally correspond to the conditions in the system Fe-P-C. (2) The other reason is that the ternary miscibility gap narrows at lower temperatures as regards the α-γ-solubility but widens as regards the solubility of "Schreibersit"; i.e., occurrences of crystallization and re-solutions of a various nature take place simultaneously. GN (5a)

Further Studies on Chromium-Nickel-Iron and Related Alloys. V. S. KRIVOBOK, *et al. Mining & Metallurgical Investigations Bulletin* 103, 1931, 40 pages.

The constitutional diagram of Cr-Ni-Fe was theoretically investigated with respect to factors influencing the existence of metastable phases and the so-called decomposition or disintegration of these alloys. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 251. Ha (5a)

The Phase Diagram of the System Iron-Zirconium. (Das Zustandsschaubild Eisen-Zirkon.) RUDOLF VOGEL & WILLI TONN. *Archiv fur das Eisenhüttenwesen,* Vol. 5, Jan. 1932, pages 387-389.

Complete phase diagram of the system Fe-Zr is given, as developed on basis of cooling curves and structure investigations. Fe and Zr form a compound Fe_3Zr_2, fusion point 1640° C. δ-iron dissolves 7% Zr in formation of mixed crystals. The δ-γ-transformation results in a so-called "second fusion point." Solubility of Zr in γ-Fe at 1330° C. amounts to 0.7%, and in dissociation of γ-mixed crystals at 830° C. solubility in α-iron decreases to 0.3% Zr. β-Zr also forms mixed crystals with Fe, which upon solidification are saturated with 5% Fe. Due to the transformation of Zr, solubility at 1000° C. in α-Zr is increased to roughly 10% Fe. Pure electrolytic Fe, and Zr, obtained by decomposition of the iodide, were used. Zr contained only traces of Si, Hf and W. To make the low Zr alloys, the Zr was added in form of small pieces of sheet to molten Fe, while for the rich alloys small Fe and Zr rods were heated together. A vigorous reaction shown by a bright flaring up of the mixture took place between Fe and Zr far below fusion point of Fe. With alloys of more than 25% Zr, temperatures became so high that they could no longer be measured with a noble metal thermocouple (Pt = Pt-Rh). Samples were all melted under argon, due to energetic reaction with N, O, H, and CO at high temperatures. Fusion temperature of pure Zr assumed from Zwikker and De Boer's work to be 1857° C. Structure diagrams of 3%, 10%, and 40% Zr-alloys are given. GN + DTR (5a)

Transformation of White into Gray Tin (Ueber die Umwandlung von weissem in graues Zinn). G. TAMMANN & K. L. DREYER. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 199, July 8, 1931, pages 97-108.

The speed of the transformation of white into gray Sn was determined by measuring the growth of the diameters of the "warts" formed when rolled strips of white Sn are inoculated with gray Sn in contact with $(NH_4)_2SnCl_6$ solution. The speed varies directly as the time, passes through a maximum at -30° C., diminishes with increase in grain size, and is slightly dependent on the orientation of the grain. Polishing with emery decreases the speed appreciably, though irregularly. Cold working increases the speed. Impurities, especially Zn, Cd, Cu, Ag, Pb, Bi and Sb interfere with the change. Addition of 0.5% of Bi or Sb prevents the formation of gray Sn. Bi is more effective than Sb, for the Sb-Sn alloys tend to darken. When test pieces carrying warts of gray Sn are heated to 100° C. to restore the white form and then cooled to -10° C., the speed of the transformation was increased, the increment diminishing with the time of heating. (5a)

Theory of Arranged Solid Phases. II. Diffusion Phenomena (Theorie der geordneten Mischphasen. II. Diffusionsvorgänge). G. WAGNER (University of Jena). *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 177-186.

The second paper (see *Metals & Alloys,* Vol. 2, Nov. 1931, page 250) treats the subject under the following headings: (1) statement of the problem; (2) deduction of formulae for the diffusion of components in arranged mixed phases, (a) general case, (b) the iron nitride type Fe_4N; (3) the specific diffusion constant of the components in arranged mixed phases; (4) diffusion and ion mobility. 7 references. EF (5a)

Carbon and Iron. (Kohlenstoff und Eisen.) *Metallbörse,* Vol. 21, May 23, 1931, pages 963-964; May 30, 1931, pages 1011-1012; June 6, 1931, pages 1059-1060.

A review of the phenomena in the C-Fe system and of the historical development of its diagram. WHB (5a)

Study of the Systems Cu-Be, Cu-Si, Ag-Si, Ag-Be, Au-Be, Au-Si, by Cementation (Quelques résultats obtenus par la méthode de cémentatio sur les couples de métaux, Cu Gl, Cu Si, Ag Si, Ag Gl, Au Gl, Au Si). L. LOSKIEWICZ, *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 535-545. 11 references.

By heating the various metal pairs in contact and study of metallography and scratch hardness of the diffusion zones, an attempt was made to verify the correctness of the various equilibrium diagrams that have been suggested for these pairs. The hitherto unexplored Au-Be diagram appears to be of the same type as that for Au-Si. Neither of these diagrams may be as simple as that for Au-Si has been supposed to be. The work was only preliminary. Brief comment is made on attempts to get alloying by cementation with other metal pairs. B and Ag apparently alloy. HWG (5a)

Preliminary Report on the Structure of Quenched Steel. G. KURDUMOFF & I. EVENSEN. *Journal of Physical Chemistry,* Russia, Vol. 1, Issue 1, 1930; *Transactions State Physical-Technical Laboratory* No. 14, U.S.S.R.

All the data available at the present time led the authors to believe that martensite is a metastable solid solution of carbon in α iron. The following main structures of steel quenched with different cooling velocities and possessing a great hardness may be expected. (1) Tetragonal lattice having a definite axial ratio for a given carbon content. (2) Not uniform tetragonal lattice. (3) Cubic lattice. In order to check this supposition the following experiments were carried out by the authors. Specimens $60 \times 8 \times 6$ mm.^{3} were quenched in water. One end only was immersed in the water, the other part of the specimen remaining in the air. The steel investigated contained 1.04% C. The surface layer 1.5-2 mm. thick of the quenched specimen was removed. The specimens were etched in 2% alcoholic nitric acid. The macrostructure revealed 3 zones which were attacked differently by the etching reagent. The first zone was that portion of the specimen which was immersed in the water and also that part which was located slightly above the water line. It was etched slowly and uniformly. The second zone, next to the first, was etched more readily and not uniformly. The third zone was etched most rapidly. Microscopic examination revealed that the first and second zones possessed a characteristic needle-like martensitic structure. At the upper part of the second zone the dark troostitic structure was also observed; the amount of troostite is increased with the approach toward the third zone, the structure of which was entirely troostitic. The X-ray examination showed that there were austenitic lines in the first zone and that lattice was tetragonal. The austenitic lines were observed in the first and second zones. It was also observed that these lines were shifted in different directions with respect to the α iron lines. This shift gradually decreased with the approach toward the third zone. At the end of the second zone, the sharp α iron lines began to appear. These lines were superimposed upon the wide martensitic lines. There was a mixture of the cubic martensite, austenite and troostite. In the third zone there were observed only the sharp lines of α iron and the lines of Fe_3C. There was a very small change of the Herbert hardness in the first and second zones. A pronounced change in hardness was observed at the end of the second zone and this change was smaller in the third zone. For different quenching conditions, different crystal structures of martensite may be obtained. Martensite possessing the characteristic needle-like structure and great hardness is obtained when the rate of quenching is such that Ar″ point is present. A tetragonal structure is obtained when quenching is very drastic. Therefore this structure may be regarded as the first step of disintegration of austenite when disintegration begins at Ar″ point. It may be stated at the present time that the tetragonal structure represents the solid solution in which the iron atoms are arranged in the body centered and greatly distorted tetragonal lattice, the carbon atoms being arranged between the iron atoms. The disintegration of the tetragonal structure we may consider as the second step of disintegration of austenite. The transformation of tetragonal lattice to cubic is accomplished by means of a gradual decrease of axial ratios. The authors' observations seem to show that martensite possessing the cubic lattice, the parameter of which is different from that of α iron cannot be obtained and they believe that in cases when such phenomenon was discovered the lattice really was ununiform tetragonal but not cubic. AIK (5a)

The System Silver-Copper-Manganese (Das System Silber-Kupfer-Mangan). M. KEINERT. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 156, No. 4, Oct. 1931, pages 291-303.

This ternary system has been investigated carefully. It was found that, in the liquid state, segregation does not occur in alloys with less than 30% Mn. All alloys with more than 80% Ag show primary Cu and Mn containing Ag crystals in an eutectic of these crystals with Cu-Mn solid solutions. The saturation limit passes from a content of 9% Cu to a content of 20% Mn. The hardness and other mechanical properties of the alloy in the range of the saturation content of the Ag crystals can be influenced to a great extent by heat treatment so that a refining process is possible. Ha (5a)

Constitution and Formation of the Phosphide Eutectic in Cast Iron (Die Konstitution und Bildung des Phosphideutektikums im Gusseisen). M. KUENKELE. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Jan. 23, 1931, pgs. 73-78; Jan. 30, 1931, pgs. 94-98.

A new etching method which distinguishes between cementite and phosphide better than picric acid is described. See *Metals & Alloys,* Vol. 1, Dec. 1930, page 906. Ha (5a)

The Constitution of the Alloys of Copper, Zinc and Tin. *Metallurgist,* Oct. 1931, pages 154-156.

An extended abstract of a paper by O. Bauer & M. Hansen in *Zeitschrift für Metallkunde,* Vol. 22, Dec. 1930, pages 405-411. These authors, taking the work of Hudson and Jones on 47 alloys (*Journal Institute of Metals,* Vol. 14, 1915, page 98) as a basis, investigated 31 additional alloys. The system was investigated by means of thermal analysis and the study of the micro-structure of annealed and quenched specimens. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 250. VVK (5a)

Structure & X-Ray Analysis (5b)

The Development of Coarse-Structure Examination of Metallic Materials by X-Rays (Die Entwicklung der Roentgen-Grobstrukturuntersuchungen metallischer Werkstoffe). Part I. H. Reininger. *Giesserei mit Giesserei Zeitung*, Vol. 18, Aug. 28, 1931, pages 681-685.

The development and application of practical X-ray examination of the coarse structure of metals as existing today in different countries is described and discussed exhaustively. A comparison of the most important industrial countries shows a pronounced advance for America in the practical utilization while, with respect to apparatus and testing technique and the multiplicity of research, hardly a difference between the different countries could be observed. In this first installment, the development of Germany is treated in detail. 35 references. Ha (5b)

High Chromium Steels, Carbides and Inclusions. A. Westgren (Stockholm, Sweden). *Metal Progress*, Vol. 20, Nov. 1931, pages 57-61.

The author discusses X-ray and metallographic studies of Fe-Cr-C system which show 4 carbide constituents; cementite in which a number of the iron atoms are replaced by chromium atoms, the face centered cubic carbide Cr_4C, the trigonal Cr_7C_3, and the orthorhombic Cr_3C_2; in each of these, Cr atoms may be replaced by iron atoms. The peritectic nature of these alloys is discussed. The existence of a eutectic of the cubic carbide and Cr is shown. The identity of the small and large carbide aggregates in ball bearing steel is shown. The utility of the X-ray method in the study of phase identification together with the microscope is discussed. WLC (5b)

Utilization of Resonance Forces for Calculating Molecular Spacings (Abschätzung von Molekülgitterabständen aus Resonanzkräften). E. Cremer & M Polanyi (Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem). *Zeitschrift für physikalische Chemie*, Abt. B, Vol. 14, Nov. 1931, pages 435-442.

The resonance forces are derived from optical data and the distances of some planes of elementary molecular space lattices are calculated. EF (5b)

X-Rays in a Boiler Shop. Chas. O. Herb. *Machinery*, Vol. 37, Jan. 1931, pages 334-337.

An installation for routine inspection by a non-destructive method of fusion welds in high-pressure boilers and tanks is described. Ha (5b)

X-Ray Investigation of the System Sulphur-Selenium. II. The Space-Lattice of the Monoclinic Selenium. I. Modification (Röntgenographische Untersuchungen im System Schwefel-Selen. II. Raumgitter des monoklinen Selens. I. Modifikation). F. Halla, F. X. Bosch & E. Mehl. (Technische Hochschule Wien). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 11, Feb. 1931, pages 455-463.

Crystals of monoclinic Se, first modification, according to Groth, were investigated by X-ray methods, the results of which are in agreement with previous publications concerning all properties except color. The simplest elementary body includes 32 Se-atoms and has the following constants: $a' = 11.50$ A.U., $b' = 8.98$ A.U., $c' = 8.977$ A.U., $b = 90° 57'$. Aiming at the simplest arrangement, a molecular space lattice is given; the crystal molecule consists of 8 atoms. There seems to be a quadruple arrangement forming a bi-molecular racemate. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 211. EF (5b)

Advances of Transportable X-Ray Testing Equipment. (Weiterentwicklung Fahrbarer Röntgenprüfanlagen.) A. Herr. *Die Wärme*, Vol. 54, Apr. 25, 1931, page 332.

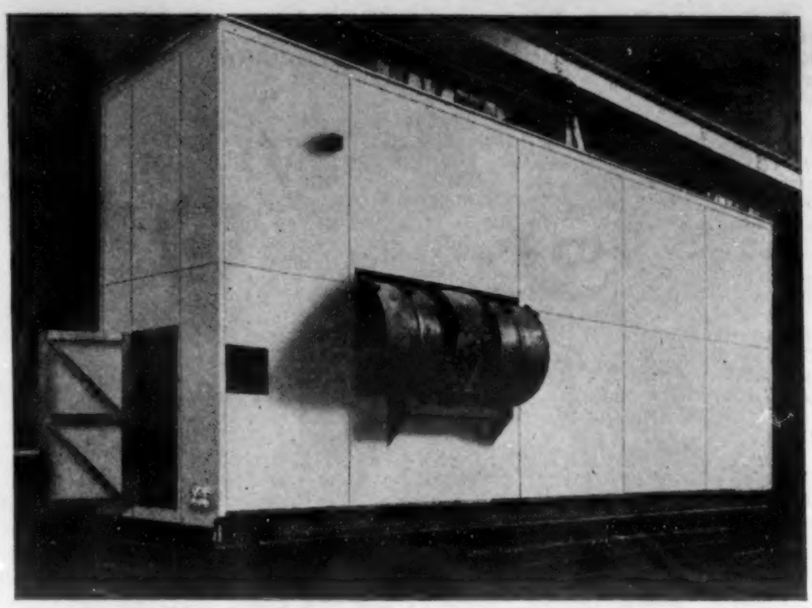
The difficulties involved in the utilization of X-ray testing equipment mounted on a truck are critically discussed and the recent developments of the German State Railroad and the German Navy are considered. The trend is mainly characterized by the possibility of easily taking to pieces the whole installation. The 2 illustrations included in the article refer to (a) the transportable "Material Isolux Röntgenanlage," System Seifert, type vertical arrangement, 180 kv./20 m Amps pulsating DC tension and (b) to the horizontal design of the same company, the data of which are as follows: 200 kv./15 m Amps pulsating DC voltage. EF (5b)

The Intensity of Quartet Lines in the Arc Spectrum of Copper. C. W. Allen. *Physical Review*, Vol. 39, Jan. 1, 1932, pages 54-63.

Intensity measurements in the arc spectrum of copper have been made for the quartets $a^4D' - c^4D$, $a^4F - c^4D$, and $a^4P - c^4D$, by using an electric arc at atmospheric pressure, and currents ranging from 1 to 19 amperes. It has been shown that the lines of these quartets may be divided into 2 groups, (1) those with initial terms $c^4D_{1,4}$ (sharp lines) and (2) those with initial terms $c^4D_{2,3}$ (broad lines), such that within each group the intensity relation of the lines remains practically constant for all current strengths. In comparison with group (1), however, the lines of group (2) increase their intensity rapidly with current strength up to about 12 amperes, beyond which they remain constant. The intensities approach nearer to the sum rule predictions for currents over 12 amperes, but even then there are some deviations. Nevertheless the similarity between the observed and calculated values supports the accuracy of the line classifications. WAT (5b)

Broad Lines in the Arc Spectrum of Copper. C. W. Allen. *Physical Review*, Vol. 39, Jan. 1, 1932, pages 42-54.

Attention is called to the anomalous broadening behavior of certain lines in the copper arc spectrum. Breadths of several lines have been measured with copper arc spectra and pressures up to 80 atmospheres. The following are the most essential conclusions: (1) broad lines with the same initial term have the same breadth; (2) all lines show a linear increase in breadth with increasing pressure; (3) lines arising from $c^4D_{2,3}$ terms have a considerable breadth at zero pressure. The discussion touches on the nature and cause of the breadth of some of the copper lines; it is concluded that the breadth is an inner property of the copper atom, that is, not due to external disturbances. The effective diameter of the copper atom would need to be increased considerably by excitation if the pressure broadening is to be accounted for by the Lorentz collision effect. WAT (5b)



Defects in Riveted Joints of Boiler Drums and their Location by Means of X-Rays. (Schäden an Nietverbindungen von Kesseltrommeln und ihre Feststellung mit Hilfe von Röntgenstrahlen.) C. F. Franzen, R. Berthold & W. Kolb. *Die Wärme*, Vol. 54, Nov. 14, 1931, pages 843-848.

The defects occurring at the riveted joints of a water tube boiler are described. In addition to the conventional investigation methods, i.e. inspection of the rivet holes, pressure test according to Stehr, etc., the X-ray examination offers a safe method of revealing defects. The potentiality and the testing equipment employed are discussed. EF (5b)

The Physics of Solids and Fluids. P. P. Ewald, T. Pöschl & L. Prandtl. Translated by J. Dougall & W. M. Deans. Blackie & Son, London, 1930. Cloth, 6x9½ inches, 372 pages. Price $6.00.

Translation of articles by the 3 authors which appeared in the 11th edition of Müller-Pouillets Lehrbuch der Physik. The sections by Pöschl (elasticity and strength of materials and friction of solid bodies, 76 pages), and by Prandtl (equilibrium and flow of liquids and gases, 203 pages) follow the usual lines of text books on mechanics and aerodynamics.

The section by Ewald (mechanical structure of solids from the atomic standpoint, 72 pages) is of the most interest to the metallurgist. It is an attempt to connect atomic properties and the properties of matter in bulk. Atomic forces and lattice energy are studied in respect to thermal expansion, thermal and electrical conductivity, compressibility, etc., the mechanics of crystal surfaces are considered, and Smekal's "weak places" in crystals are discussed. The evidence is so contradictory and ideas are so chaotic that even qualitative explanations can seldom be given.

Ewald starts his discussion of single crystals by saying, "Of the play of forces which retain the atoms of a metal in their places in the lattice, we know next to nothing." Slip, or gliding, in single crystals is discussed, and the conclusion drawn that "the technical problems of strength may gradually become accessible to the methods of theoretical physics."

The production of fibrous structure, or crystal orientation, upon working a polycrystalline material is discussed, along lines of Wever's "pole-figures," and the conclusion is that this is an extremely complicated process which has been much studied without anything more than qualitative relations having been found.

The question whether there is a finite elastic limit remains unanswered.

Ewald says that if he were asked to give a perfectly honest reply to the question how far modern physics has gone in explanation of the actual mechanical behavior of solids, he would reply that the first steps have been taken along a new road that may lead further than the old ones, but that a general theory of state for metals is still a long way off though it is the only possible foundation for a theory of strength. Even the processes in single crystals are far from easy to understand, and the further step to polycrystalline material will also be difficult.

The impression one gets from Ewald's frank discussion is that the theoretical physicist is still groping in a dense fog, and that he will continue for a long time to be baffled in his attempt to find the answers to the questions of metallurgy he is seeking to solve. H. W. Gillett (5b)-B-

Preferred Orientation Produced by Cold Rolling in the Surface of Sheets of Aluminum, Copper and Silver. C. B. Hollabaugh & W. P. Davey. (Pennsylvania State College). *Metals & Alloys*, Vol. 2, Oct. 1931, pages 246-250; Nov. 1931, pages 302-312.

49 references. In cold working a metal, the crystals fail by shear along the crystallographic planes of the largest interplanar spacing. For face centered metals considered, this failure is along the (111) family of planes as confirmed experimentally on single crystals of Al. A sheet of metal is composed in the cast or annealed condition of many crystals of continuous orientation within themselves; the sheet itself represents many orientations. On cold working, the crystal fragments have a tendency to orient themselves in preferred orientations. Metals of the same lattice shearing along the same planes should assure the same preferred orientation if no other factor enters. The other factor of possible influence is the atomic forces holding the metal in its lattice. The variety of chemical properties represented by face centered metals suggests that these forces may vary considerably. Recent work has shown that the assumption that metals of the same lattice assume the same preferred orientation is erroneous. This paper presents the results of a study of the orientation assumed by several face centered metals under the same condition of working. By use of the reflection type of defraction, only one surface is examined. The data obtained shows not a single preferred position but a range which is not the same in each case. Ni and Cu show identical limits of range and mean position in their preferred orientation. Al and Ag show related orientations but widely different angular limits dependent, in the case of Al, on the number of passes through the rolls but independent of this variable in the case of Ag. The preferred positions of all are similar only in that one face diagonal of the cube is parallel to the direction of rolling and perpendicular to the rolling surface. The similarity is consistent with their identical face centered cubic arrangement and the differences and similarities in other respects are consistent with their chemical valence. Cu and Ni, of the same valence and atomic numbers 29 and 28, respectively, show marked similarity. Al, with a valence of 3 and atomic number of 13, is markedly different from Ag with a valence of 1 and atomic number of 47 and both are different from Cu and Ni. A comprehensive review is made of the literature on the subject. The experimental technique of making the X-ray examination, the annealing and rolling treatment of the samples are described in detail. The difference in preferred orientation is discussed in the light of the chemical properties of the individual metals. Al is shown to be very sensitive to rolling conditions while the other 5 metals are comparatively insensitive to increasing number of passes. WLC (5b)

Recent Progress in Testing of Materials by X-Rays with Special Regard to Completely Built-in Boilers and Apparatus (Die neueren Fortschritte in der Material-Röntgenuntersuchung unter besonderer Berücksichtigung von fertig eingebauten Kesseln und Apparaten). A. Herr. *Schmelzschweissung*, Vol. 10, Nov. 1931, pages 258-262.

It is noted that, for very valuable objects, the X-ray investigation should not be restricted to the finished product but should start during the early manufacturing process. This will often save very expensive repairs while the testing in earlier stages requires only a negligible outlay. The safety of operation, economy, reliability of X-ray testing as applied with modern apparatus is discussed and illustrated by many examples. 10 references. Ha (5b)

X-Ray Analysis of the Copper-Silicon Alloys (Röntgenanalyse der Kupfer-Silizium Legierungen). S. Arrhenius & A. Westgren (University of Stockholm.) *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 14, No. 1, 1931, pages 66-79.

The constitutional binary diagram Cu-Si was re-established by means of an X-ray investigation (powder method, Fe-K radiation). One set of the alloys was quenched in water from a temperature just below the melting point, while a second set of samples was drawn at 550° C. The experiments disclosed the existence of 5 different intermediate phases, 2 of which ($\beta + \delta$) are only stable at elevated temperatures; 2 of which ($\gamma + \epsilon$) are only stable at ordinary temperature; while η forms on solidification and remains stable down to room temperature. The following statements on the various phases are given: (1) β, hexagonal close-packed atomic arrangement, 14.5 atomic %-Si, $a_1 = 2.588$ A.U., $a_3 = 4.176$ A.U., $\frac{a_3}{a_1} = 1.633$. (2) γ, same structure as β-Mn, 17 atomic % Si, parameter = 6.210 A.U., 20 atoms in the unit cell, formula Cu_5Si. (3) δ with 18 atomic % Si has probably the same structure as deformed γ-brass (4) ϵ with 21 atomic % Si belongs to the body centered cubic atomic arrangement; parameter = 9.694 A.U., number of atoms in the unit cell: 76; formula: $Cu_{15}Si_4$. (5) η contains 25 atomic % Si, hexagonal arrangement similar to the cubic type of β brass. The space lattice dimensions are subject to only small changes due to varying concentrations within the ranges of homogeneity. The authors compare their constitutional diagram with the latest one proposed by C. S. Smith (Transactions A.I.M.M.E., 1929, page 414). EF (5b)

X-Ray Crystal Analysis. *Engineer*, Vol. 152, Sept. 25, 1931, page 326.

Editorial commenting on a publication of the Department of Scientific and Industrial Research by Sir William Bragg. Regrets that report does not deal sufficiently with problems of practical importance to the engineer. LFM (5b)

X-Ray Application to Wire and Wire Products. N. P. Goss. *Wire & Wire Products*, Vol. 6, June 1931, pages 217, 219.

A brief treatise on the manner in which the metallurgical engineer may conclude from diffraction patterns made with X-rays on the presence of certain atomic structural arrangements which indicate physical characteristics not suitable for the purpose for which the material is intended. Ha + WHB (5b)

Incoherent Scattering of X-radiation. (Über die inkohärente Streuung von Röntgenstrahlen.) W. Heisenberg (University of Leipzig) *Physikalische Zeitschrift*, Vol. 32, Oct. 1, 1931, pages 737-740.

The writer applies the methods of Thomas and Fermi to derive an equation for the incoherent scattering of X-rays. EF (5b)

Incoherent Scattering of X-radiation. (Über inkohärente Streuung von Röntgenstrahlen.) L. Bewilogua (University of Leipzig) *Physikalische Zeitschrift*, Vol. 32, Oct. 1, 1931, pages 740-744.

The article pertains to a discussion of Heisenberg's equation for incoherent scattering of X-rays (see abstract above) and arrives at the conclusion that the effect of incoherent scattering is only a small fraction of the total except at high angles and with light atoms. EF (5b)

X-ray Examinations in Industrial Plants. (Röntgenuntersuchungen im Werkstättenbetrieb.) C. Kantner & A. Herr. *Metallwirtschaft*, Vol. 10, Sept. 11, 1931, pages 717-720.

Contains 5 references. Examination of metals by penetration with X-rays has become especially useful in the field of welding. The quality of welding has been considerably improved and confidence of engineers in the reliability of properly made welds has been increased. Recently X-ray examination of welds made on steel buildings and bridges has been carried out at the locations, instead of in the laboratory only, as formerly. In general visual examination is sufficient and photographs are necessary only in special cases. Methods of shielding certain surfaces with sheet Pb so that the images of several welds do not overlap are described. A telescopic device has been developed, by which hollow bodies and tubes can be examined indirectly, not in the line of the X-rays. The image can also be magnified in the same device. It was found that when welded test pieces which showed porous spots in the weld were broken in a tensile machine, the fracture started not in the porous spot but in the concentric layers around the porous spot. CEM (5b)

The X-Ray Determination of Elastic Stresses in Bent Crystals. (Die röntgenographische Bestimmung elastischer Spannungen in gebogenen Kristallen.) S. Konobejewski & I. Mirer. (Institute of Non-Ferrous Metals, X-ray Department, Moscow.) *Zeitschrift für Kristallographie*, Vol. 81, Jan. 1932, pages 69-91.

The principal results of the investigation are: (1) Laue patterns of bent rock salt and gypsum crystals show asterism due to the elastic deformation of the space lattice. (2) According to the Laue pattern a re-bending of the rock salt crystal in its original position also straightens the lattice. (3) In recrystallization the bent lattice lamellae disintegrate to small fragments; the original lattice does not reappear upon re-bending. (4) A method is described to calculate the elastic stresses from the X-ray pattern. (5) By designing and evaluating the stereographic projections the elastic stresses were determined to amount to about 83,900 lbs./in.² 10 references. GN (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Some Tests on the Magnetic Secondary Effects (Einige Versuche über die magnetische Nachwirkung). H. Kühlewein, *Physikalische Zeitschrift,* Vol. 32, June 15, 1931, pages 472-480.

The occurrence of retardation disturbances was observed in some kind of relays incorporating highly permeable alloys. Two methods were developed for determining the time curve of magnetization. Experiments were carried out on pure permalloy (78.5% Ni, 21.5% Fe), in the annealed state and after slowly cooling (40% Ni, 60% Fe) in the same two states; Perminvar (35% Ni, 25% Fe, 30% Co) after slowly cooling and charcoal iron after the same treatment. Only Permalloy exhibited pronounced magnetic secondary effects in the tested frequency range. The rest of the paper relates to experiments with the Helmholtz pendulum on the slope of the time/induction curve with reference to Permalloy, Permalloy containing 1.5% Si, 40% Ni, 60% Fe and charcoal iron after various treatments. EF (6)

Gain in Strength by Preliminary Stress (Materialverfestigung durch Vorspannung). E. Kressig. *Glasers Annalen,* Vol. 55, Nov. 1, 1931, pages 77-80; Nov. 15, 1931, pages 85-88.

Formulae covering the stress of material are developed, based on the hypothesis of elongation, and used for evaluating the strain hardening effect of preliminary stresses. EF (6)

The Deformation of Metals under Prolonged Loading. D. Hanson & M. A. Wheeler. *Engineering,* Vol. 132, July 10, 1931, pages 56-58; July 24, 1931, pages 120-122.

Condensed from paper read before the Institute of Metals, March 12, 1931. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 144. LFM (6)

Magneto-elastic Phenomena in Relation to the Elastic Limit (I fenomeni magneto-elastici in relazione al limite di elasticita). G. Guzzoni & D. Faggiani. *La Metallurgia Italiana,* Vol. 23, Nov. 1931, pages 1029-1045.

Magnetic tests were carried out on hard drawn and annealed wires of 0.09% and 0.85% C steel; on 0.09% C, 0.12% Ni; 0.36% C, 2.04% Ni; 0.24% C, 2.92% Ni; 0.16% C, 4.28% Ni and on Invar, A.M.F., and Permax alloys, 0.03% C, 35.03% Ni; 0.10% C, 45.20% Ni; 0.03% C, 76.12% Ni, with the wires under different tensile stresses. The elastic limit as ordinarily determined does not coincide with any particular variation in magnetic induction. The "elastic limit," as usually determined, is higher than the stress producing the beginning of permanent deformation. The curves of induction do not allow detection of the beginning of plastic flow. Contains 13 references, 13 figures, 18 tables. HWG (6)

Flow Tests on Steel Tubes under Combined Pulling and Torsion Stress. (Fliess versuche an Rohren aus Stahl bei kombinierter Zug- und Torsionsbeanspruchung). K. Hohenemser (University of Göttingen) *Zeitschrift für angewandte Mathematik und Mechanik,* Vol. 11, Feb. 1931, pages 15-19.

Experiments were performed with the Losenhauser Testing Machine (max. pulling capacity = 15,000 kg. and torsion moments of 15,000 kg./cm.) on open hearth steel with 0.08% C and 0.5% Mn after annealing at 950° C. The results are in accordance with the Hencky equations on flow, but did not verify the Reuhs Theory. In addition to the flow in metals during constant stress, states are encountered in which, although the stresses are approaching the yield point, an unequivocal relationship exists between stress and elongation. EF (6)

Load Tests with Cylindrical Steel Helical Springs. (Belastungsversuch mit zylindrischen Schraubenfedern aus Stahl.) Max Ensslin. *Maschinenbau,* Vol. 10, Aug. 6, 1931, pages 496-500; Aug. 20, 1931, pages 536-540.

The article presents a method for calculating the strength of helical springs by tensile, pressure and torsion tests. The influence of much overloading of the spring before usage, the influence of recoil, and the behavior of cold rolled springs with and without supplementary heat treatment, is investigated. The twenty cylindrical helical springs tested have, under tensile or pressure loads, a shear elasticity modulus of G = 772,000 to 879,000 kg./cm.[2] The range and upper limit is greater than for structural steel. Determination of the usual spring load is made by means of the modulus of the same spring. MAB (6)

Hardness Testing by Measurement of the Depth of Penetration. (Die Harteprüfung mit Tiefenmessung.) O. Dettinger. *Maschinenbau,* Vol. 10, Jan. 1, 1931, pages 14-18.

Tests were carried out on unhardened carbon steels. Two modifications of the new portable Brinell machine are described. A ball of 2.5 mm. diameter and with a load of 187.5 kg. was used. The loading was effected by a system of springs. A curve was made by which the depth of the impression can be read directly in the apparatus. The possibility of determining the tensile strength by comparison with the Brinell number is discussed. MAB (6)

On the Interpretation of Some Ferromagnetic Phenomena. Francis Bitter. *Physical Review,* Vol. 38, Jan. 1932, pages 337-345.

A paper in the Symposium on Ferromagnetism of the American Physical Society, Sept. 1931. During these first years of the twentieth century our knowledge of ferromagnetism has made great progress. We have learned empirically how to make those magnetic materials which are the foundation of the countless electrical circuits woven around the earth. Instruments have been built to work equally well under most varied conditions. Materials are available that will respond to the enormous forces produced by generators in power stations, to the faint current signal produced by sounds thousands of miles away. We are beginning to learn something of the mechanisms which are responsible for the existence of ferromagnetism and for the various phenomena associated with it. Starting with the conception that magnetic materials are made up of atomic magnets in thermal interaction, and that magnetization results from their reorientation, the paper outlines our present knowledge of ferromagnetism, and indicates a few places along the above lines where progress is to be expected. WAT (6)

Dynamic Fracture Tests on Airplane Framework. (Dynamische Bruchversuche mit Flugzeugbauteilen). H. Hertel. *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 22, Aug. 14, 1931, pages 465-474; Aug. 28, 1931, pages 489-502.

Testing devices and procedures developed by the Deutschen Versuchsanstalt für Luftfahrt for testing the vibration strength of airplane spars, with and without static loads, are described. 10 metal spars and spar parts, consisting of welded and riveted steel spars, steel spar framework, and duralumin spar framework, as well as 2 wooden spars, were tested up to fracture. The wooden spars displayed no reduction in the durability of the spar flange, compared with that of the working materials on the test stand. The durability for the metal spar, on the contrary, amounted to only a fraction of the value expected from the durability points of the working materials, because a local tension increase appeared which amounted to a multiple of the average tension fixed in the calculation. The good results obtained with wooden spars were at the fixed cross-sectional parts, and stress arrangements and glued joints were satisfactorily reduced for the working material. The unsatisfactory results with metal spars are shown in the detrimental increase of tension at the rough cross-sectional parts (butt straps and gusset plates), in the single and double riveting, and in the detrimental effect of machining on the properties of the working materials used in the construction. WAT + WHB (6)

Some Notes on the Alternating Bend Test for Thin Mild Steel Sheets. J. C. Godsell (Swansea Municipal Technical College). *Sheet Metal Industries,* Vol. 4, Mar. 1931, pages 936-937.

Paper before Swansea Technical College Metallurgical Society. The work was an investigation of the influence of some factors on the Jenkins bend test. Length and width of strip tested were found to have no effect on the values obtained as were speed of testing, and additional pressure on the roller. Direction of test with respect to direction of rolling altered the values. The value of the radius vector for any given angle may be calculated from the formula

$$n\Theta = \sqrt{n^2_0 \operatorname{Cos}^2\Theta + n^2_{90} \operatorname{Sin}^2\Theta}$$

where n = number of bends and 0°, 90°, and Θ = inclination of test strips to direction of rolling. AWM (6)

Hardness Tests on Chilled Castings. (Die Prüfung der Härte von Schalenhartguss). O. Heune. *Der Papier-Fabrikant,* Vol. 29, Apr. 19, 1931, pages 244-249.

Experiments were carried out to investigate the sources of error involved in the Brinell hardness test on chilled castings. The deviation of the indentation mark from the circular form is stated to be responsible for the irregular measuring results. The occurrence of cracks at the edges of the ball impressions and the kind of balls used were furthermore found to exert an influence. The performance of at least 3 determinations is suggested. A deviation of more than 1% of the average hardness value is not generally to be expected. A further source of error, not due to the Brinell hardness testing method, but due to the round surface of the chilled castings is pointed out. In summary, it may be stated, that the Brinell method can be used successfully for testing chilled castings. EF (6)

On the Measurement of the Resistance of Shield Plates to Penetration by a Rifle Bullet. K. Honda, G. Takemae & T. Watanable. *Kinzoku no Kenkyu,* Dec. 1931, pages 619-632 (In Japanese); *Science Reports Tohoku Imperial University,* Vol. 19, pages 703-725 (In English).

An investigation was carried out to measure quantitatively the efficiency of a shield plate in resisting penetration by a rifle bullet. A steel specimen was set at the front of a large sand box suspended from a ceiling frame as a ballistic pendulum. Since the displacement of the sand box caused by the impact of the rifle bullet is small, it was magnified by a device similar to that used in a seismograph. The residual velocity of the bullet after passing through a test plate was obtained from the displacement of the sand box. A so-called "characteristic curve" showing the shielding efficiency of a metal was obtained for different metals and alloys. The curve not only gives the residual velocity of a bullet after passing through a shield plate of a given thickness, but also the thickness of the metal plate which is just sufficient to stop the impinging bullet, or the "penetration distance." The best material found as the result of the investigation is a special steel, the penetration distance of which is 4.5 mm. for a bullet 9 g. in mass and of a velocity 790 m./sec. An effective material for resisting penetration by a bullet must possess a great hardness combined with toughness. In the case of plain carbon steel and other metals, great hardness is always combined with brittleness, so that a good material for an effective shield plate must be sought for in special steels. The most effective material found by the investigation is a heat-treated special steel, which with a thickness of 4.5 mm. completely stops a bullet 9 g. in mass and 790 m./sec. in velocity. A single plate is more effective than a laminated plate of equivalent thickness. Two plates of equal thickness separated from each other by a distance are more effective than a single plate of equivalent thickness; the effect of separation is greater as the distance increases. TM (6)

Measuring the Magnetic Saturation (Zur Messung der magnetischen Sättigung). E. Gerold. *Archiv für Eisenhüttenwesen,* Vol. 5, Nov. 1931, pages 267-268.

In using the apparatus of Gumlich, a relation can be established which permits the calculation, with sufficient accuracy, of the magnetic saturation at a certain field strength when one value of induction has been measured. When, in magnetizing with a current of 1 ampere the induction, B has been found and the saturation is then calculated according to the normal graphic method of Gumlich to be $4\pi I_\infty$, the equation holds true: $4\pi I_\infty = B_{1A} \times 1.018 - 5400$. Many time-consuming measurements can thus be avoided. 4 references. GN (6)

The Testing of Strip Copper and Copper Alloys. Maurice Cook & E. C. Larke. *Metal Stampings,* Vol. 4, Nov. 1931, pages 897-898, 926.

The physical testing of thin strips for specified work by tensile, hardness and cupping tests is discussed. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 306. Ha (6)

On the Transverse Effect of the Magneto-striction. (Ueber den Quereffekt der Magnetostriktion.) G. Dietsch & W. Fricke (University of Jena). *Physikalische Zeitschrift,* Vol. 32, Aug. 15, 1931, page 640.

The transverse effect of the magneto-striction, i.e. the cross section changes of ferro-magnetic poly-crystalline material in magnetic fields was studied by 2 testing methods developed in the Physikalisches Institute of the University of Jena. A short description of the methods, the sensitivity of which amount to 10^{-8} cm., and a characteristic testing curve gained on vacuum melted electrolytic iron are presented. EF (6)

On the Transverse Effect of the Magneto-striction. (Ueber den Quereffekt der Magnetostriktion.) A. Esau (University of Jena). *Physikalische Zeitschrift,* Vol. 32, June 15, 1931, pages 483-485.

The transverse effect of the magnetostriction (see abstract above) is computed for soft iron, Ni, Co and Ni steel containing 29, 36 and 46% Ni. EF (6)

The Yield Point and Initial Stages of Plastic Strain in Mild Steel Subjected to Uniform and Non-Uniform Stress Distributions. Gilbert Cook. *Transactions Royal Society of London,* Vol. 230, 1931, pages 103-147.

The paper describes an investigation carried out to determine for mild steel, (1) the relation between the stress at the yield point in simple tension and in the non-uniform distribution produced by torsion, flexure, and internal pressure in a hollow cylinder, and (2) the stress distribution in each of the latter cases in the early stages of overstrain. Apparatus is described for obtaining load-deformation diagrams in which the true resistance to deformation during overstrain is measured. Those obtained for the non-uniform distribution are compared with theoretical diagrams based upon the assumption that a specific shear stress causes the initial breakdown, and that the initial stages of plastic strain take place at a uniform, but lower, shear stress. It is shown that the maximum shear stress at the initial yield point is consistently higher in the non-uniform distribution than in uniform tension. In the cylinders a pronounced scale effect was observed. All the results are consistent with the supposition that the initial dislocation resulting in elastic breakdown takes place at a critical value of the shear stress at a certain depth in the material, in other words, that a surface layer exists possessing the same elastic properties as, but higher elastic limit than, the interior. In the initial stages of overstrain, the load-deformation diagrams follow closely the theoretical shape, and confirm the assumption that a lower stress exists in the overstrained parts than is required to initiate the yielding process. The author suggests that the stress reduction is a consequence of variations in load from one crystal grain to another. Irreversible and discontinuous displacements occurring either at the crystal boundary or in the interior of the crystal, which are associated with the process of slip, are regarded as affording relief to the reversible elastic distortion in the same crystal, the amount of relief depending upon the magnitude of the individual displacements. WAT (6)

Influence of the Velocity of Deformation on the Deformation Resistance. (Einfluss der Verformungsgeschwindigkeit auf den Verformungswiderstand.) W. Tafel & E. Viehweger. *Zeitschrift Verein Deutscher Ingenieure,* Vol. 75, Dec. 5, 1931, pages 1479-1483.

A series of static and dynamic tests for determining the dependency of the average flow limit upon the velocity of deforming is described and the formula of Fink used for the calculation of the dynamic stresses. A relation is found between the static and dynamic stresses which can be expressed by $\delta_{dyn} = 2V_m + \delta_{m\ stat} + \Delta\,\delta$. The tests lead the authors to the conclusion that the official regulations for riveting steels should be revised by defining the exact upsetting temperature and number of blows. Ha (6)

New Methods and Results of Elasticity and Sound Velocity Measurements in Solid and Molten Metals. (Ueber neuere Methoden und Ergebnisse der Elastizitäts-und Schallgeschwindigkeitsmessungen in festen und geschmolzenen Metallen.) O. Stierstadt. *Metallwirtschaft,* Vol. 11, Jan. 8, 1932, pages 18-21; Jan. 15, pages 32-34.

Contains 12 references. The velocity of sound through metal is measured by attaching two microphones to the metal rod at different distances from the end where the source of sound is placed. If each microphone is connected to an earphone the sound will reach the two ears at different intervals. By inserting a direction compensator and adjusting it so that the sound from the two microphones reaches the ears at the same instant, the velocity of the sound can be calculated. Molten metals are placed in a tube and the velocity is determined in a similar manner. Measurements on several metals proved that the velocity through the solid metal is very nearly two times the velocity through the molten metal. Bi is an exception, the velocity through the solid metal being lower. By a series of mathematical deductions the author gives relationships between the sound velocity, compressibility, modulus of elasticity and specific heat of solid and liquid metals. CEM (6)

Physical Testing During the Assembling of Boiler Water Tubes, Pipe Lines and Fittings. (Bauüberwachung von Kesselsiederohren, Rohrleitungen und Armaturen.) H. Stehr. *Die Wärme,* Vol. 54, Apr. 25, 1931, pages 309-311.

The technique of carrying out the different bending tests on tubes for boiler systems are discussed and illustrated. The lecture was delivered at the Zentralverband der Preussischen Dampfkessel Überwachungsvereine, 1931. EF (6)

Testing of Tubes and Super-heater Pipes. (Abnahme von Rohren und Überhitzer-schlangen.) R. Schnabel. *Die Wärme,* Vol. 54, Apr. 25, 1931, pages 309-311. Sonderheft "Werkstoff und Herstellung in neuzeitlichen Dampfkesselbau."

The different manufacturing methods of seamless boiler water tubes, the sources of trouble in the manufacturing processes, the traditional testing methods for the material in the as-received state are fully dealt with in this paper which was presented before the Zentralverband der Preussischen Dampfkessel Überwachungsvereine, 1931. EF (6)

Investigation of the Influence of Heat Treatment of Structural Steel on Its Behavior in a Drilling Test. (Versuche über den Einfluss der Wärmebehandlung von Baustahl auf sein Verhalten beim Bohrversuch.) W. Schwinning & G. Gutberlet. *Maschinenbau*, Vol. 10, Mar. 5, 1931, pages 178-183.

Tests were made on five structural steels (St 37, St 48, St 52, VCN 35 and an unalloyed tool steel). The effect of a systematic variation in structure obtained by gradual annealing on the machinability was made on tool steel chips. The mechanical properties of the heat-treated material (hardness, tensile strength, elastic limit, elongation, reduction of area, notch impact strength) were determined and compared as a means of explaining the relationship between the structure and behavior in the drilling test. MAB (6)

Notes on the Hardness Testing of Metals. *Sheet Metal Industries*, Vol. 5, July 1931, page 236; Sept. 1931, pages 352, 357, 358; Oct. 1931, pages 431-432, 437.

From a pamphlet issued by Wild-Barfield Electric Furnaces Ltd., Elecfurn Works, North Road, Halloway, N 7. The introduction points out that the Vickers method will be dealt with and shows the fallacy of a spherical indenter in that the relation between diameter and surface area of 2 unequal impressions will not be the same. Then, since diameter alone is measured, it follows that the readings will be fallacious. The diameter of impression in Brinell testing which yields the ideal is taken as being ⅜ the diameter of the ball. The angle of the Vickers pyramidal diamond is 136° which is the angle arrived at by subtending the tangents of the extremities of the ideal ball impression. A test to verify the accuracy of the Vickers test is outlined. Errors of the ball indenter are given as, its spherical form and distortion of the indenter, while the diamond indenter is not subject to deformation at normal loads. The area of impression is in direct proportion to the hardness with a given load. The hardness reading will be the same and strictly in accordance with the Brinell equation $\frac{\text{load}}{\text{area}}$, irrespective of load. The accuracy of the Vickers method and the ease of reading the diagonal of the impression obtained are discussed. The cost of maintenance is set at \$4-5 for relapping the diamond. This is necessary at intervals varying from 6 mo. to 2 yrs. depending on the materials tested. AWM (6)

A "Magnetic Sharpener." L. W. McKeehan. *Physics*, Vol. 1, Dec. 1931, pages 388-392.

The research was carried out at Yale University. The claim that the mere placing of a double-edged safety razor blade upon the poles of a permanent magnetic of special design has a sharpening action has been investigated by studying the characteristics of the device and by testing the sharpness of blades so treated in comparison with untreated and with mechanically stropped blades. No definite "magnetic sharpening" was observed to occur in these tests. The method of measuring the sharpness was similar to that used by Honda and Takahasi (Scientific Reports Tohoku Imperial University, Vol. 1, No. 16, 1927, pages 755-773). The blade, mounted vertically in a brass block with cutting edge horizontal, was drawn slowly to and fro across a stack of paper strips clamped on a metal base. The paper was a good grade of condenser paper about 0.0013 cm. thick. The number of pieces of paper cut in a given number of strokes was a measure of the sharpness. There is positive evidence that mechanical stropping helps in maintaining a fair degree of sharpness. A conspicuous feature of these data is the wide difference which may exist between properties of edges intended by manufacturers to be alike, that is, the edges of a single blade. This makes generalization from a few cases particularly dangerous, but the effect of treatment in the "magnetic sharpener" is less beneficial than advertising claims in such phrases as these: "An instantaneous, automatic sharpener, in which a powerful magnetic takes the place of all stropping, honing or crank-turning" — "the strong magnetic of the amazing sharpener instantly draws the bent 'teeth' into straight and true alignment — restoring factory keenness absolutely." Extravagant statements like these, if untrue, can only diminish the confidence of the general public in better-founded claims presented for inventions in which physical principles are correctly applied. WAT (6)

Apparatus for Measuring Elongation. (Messgeräte für Dehnungsmessungen.) Ernst Lehr. *Maschinenbau*, Vol. 10, Dec. 3, 1931, pages 711-725.

Includes 57 references. The constructor must, if he wishes to build with the least expense and yet safely, recognize the fact that stresses will occur in the structures, and he must know where they are distributed. This knowledge can be obtained only by means of elongation measurements. Static elongation measurements will serve to determine the spatial distribution of stresses in the structure and particularly to locate the extent of the strains and the time of load. The apparatus which have been accepted for carrying out such measurements is described in the article. MAB (6)

Changes in the Dimensions of Metallic Wires Produced by Torsion. II. Silver, Gold, Aluminum and Nickel. III. Lead. Thomas Lonsdale. *Philosophical Magazine and Journal of Science.* Series 7, Vol. 11, June 1931, pages 1169-1196.

The papers give the measurements of the changes in lengths of the metals named in the form of wires when they are twisted at room temperature. Considerable elongations are produced by twisting even under very small tensions. Five references. Ha (6)

International Testing Congress Discusses Impact and Cast Iron. Correspondence from A. Portevin, Paris, France. *Metal Progress*, Vol. 21, Feb. 1932, pages 67-68.

The writer discusses some of the matters presented at the Zurich meeting September 1931. WLC (6)

Electromagnetic Testing for Mechanical Flaws in Steel Wire Rope. (Elektromagnetische Prüfung von Stahlseilen auf mechanische Risse). T. F. Wall. *Elektrotechnische Zeitschrift*, Vol. 52, No. 14, 1931, page 448; *Journal Institution Electrical Engineers*, Vol. 67, 1928-29, pages 899-911.

See *Metals & Alloys*, Vol. 1, Feb. 1930, page 383. (6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Test Results and Service Values of Materials. H. F. Moore. *Lecture at joint meeting American Society for Testing Materials and American Institute of Mining & Metallurgical Engineers*, Feb. 18, 1932, Advance Copy, 7 pages. Mimeographed.

Making of accurate tests and deciding what they mean in terms of service are 2 different things. Ductility tests are ordinarily taken as showing service value, but it is difficult to conceive of a structure which can utilize more than 5% deformation without failing to function. Good tests are needed to indicate ability to withstand spreading of a crack under repeated stress and to defeat high localized stress. All accelerated corrosion tests are regarded as of doubtful reliability. Impact tests on notched bars were developed without knowledge that they measure important qualities, but rather because they were easy to make and because it seemed reasonable that a material with high resistance in the test must be able to stand punishment in service. Comparison of service results is tending to establish the test as a valuable one. Delicate proportional limit determinations do not appear to measure as important service properties as do tests with greater plastic deformation as the criterion. Attention is called to the proposed new A. S. T. M. definition of yield strength and methods for determining it. Endurance limit data are valuable in respect to machine parts, but not to most structures. The test should be correlated with the service. Tests for creep at high temperatures give promise as of great engineering significance. HWG (6f)

Tables of Elastic Properties of Alloys. C. H. Kent. *University of Nevada Bulletin*, Vol. 23, No. 6, Oct. 1, 1929; *Engineering Experiment Station Bulletin* No. 2, 55 pages. Price 20c.

This is a compilation of data from various American sources. It could well have been extended to include foreign data. The individual references from which the data are taken are not given so the user will often have difficulty in checking back to the original source for more complete information. This is the main drawback of the compilation. The term "elastic properties" as here used is a broad one; special attention is given to tabulation of endurance properties of various steels and non-ferrous alloys. Considerable attention is paid to high temperature properties of metals and heat-resistant alloys, but since these data are chiefly of the 1910 to 1924 vintage, they are not particularly valuable. There are data on C steels, S.A.E. steels, Mo steels, Ni steels and cast irons, Si steels, bearing metals, die casting alloys, Cu-Be alloys, etc. The only original material is found in the brief introductions to the various sections. These are good, that to the section on endurance being especially to the point. On the whole, the compilation is a useful one. HWG (6f)

Contribution to the Problem of Fatigue of Metals. (Zur Problemstellung der Metallermüdung.) W. Kuntze. *Metallwirtschaft*, Vol. 10, Nov. 27, 1931, pages 895-897.

Contains 13 references. The author attempts to prove that there is no disagreement between himself and Sachs-Laute in their theories on fatigue of metals, especially in regard to strengthening by understressing. He shows graphically that the fracture by repeated alternating stress is always at the intersection of the tensile strength line and the resistance to change in shape line. It is not a case of strengthening during the first cycles and a tendency toward fracture during later cycles, but both occur at the same time with the tendency to fracture outweighing the strengthening. Understressing functions first to increase tensile strength and, second, to reduce disintegration. The endurance limit is higher than the endurance yield point by an amount proportional to the understressing capacity. The formula,

$$\text{endurance limit} = \text{endurance yield point} \times \frac{\text{tensile strength of unstressed material}}{\text{tensile strength of material stressed to initial fracture}}$$

has been checked by numerous tests on various materials. However, the endurance yield point disappears when the number of cycles increases beyond the point where the material loses its plasticity. CEM (6f)

The Static and Fatigue Properties of Brass. J. B. Kommers. *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 2, 1931, pages 243-258.

Includes discussion. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. HWG (6f)

Nickel Tubing Resists Fatigue. R. Worthington. *Automotive Industries*, Vol. 66, Jan. 30, 1932, page 164.

Stress-cycle endurance curves, to 100 million cycles, are shown, as determined at Wright Field, for tubing. These show:

Material	Elongation % in 2 in.	Endurance Limit 100 Million Cycles lbs./in.^{2}
Hard drawn Ni, surface ground	9½	42,000
Annealed Ni, surface ground	48½	29,000
Hard drawn Cu, surface as drawn	4	22,000
Annealed Cu, surface as drawn	56	12,000

Vibration tests at higher stresses place the materials in the same order as do the endurance tests. Annealing of airplane fuel line tubing does not produce improved resistance against repeated stress. Annealed Ni tubing is suggested for this use as it combines ease of bending with good endurance limit. The article contains a good discussion of the significance of short-time bend tests as compared with long-time fatigue tests. HWG (6f)

ELECTRO-CHEMISTRY (7)

Electrochemistry of Magnesium (Zur Elektrochemie des Magnesiums). SVEN BRODFORSS. *Zeitschrift für physikalische Chemie,* Vol. 153, Feb. 1931, pages 83-106.

The change of potential of a Mg-electrode with time was determined in $MgSO_4$ and $MgCl_2$ solutions. The effect of varying the acid content and varying the buffer in the presence of neutral salts and NH_4 salts or of hydroquinone, resorcinol succinimide, phrocatechol, CO, CO_2 and H_2 was determined. Mg becomes less noble as the pH concentration of the solution is increased, till a maximum is reached. This is explained by the reaction Mg $\rightleftarrows$ (ion) + e or 2Mg $\rightleftarrows$ Mg_2 (ion) + $2e$. Ha (7)

Theory of the Velocity of Diffusion of Strong Electrolytes in Dilute Solution. G. S. HARTLEY. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Aug. 1931, pages 473-488.

The paper considers the diffusion velocity of strong electrolytes in the light of the activity function and derives a theory based on a uniform pressure acting on any elementary layer of the liquid which is equal to the difference of the osmotic pressure at the 2 surfaces of the layer. Additional forces are exerted on the ions because of the gradient of electrical potential. 17 references. Ha (7)

Oversaturation Phenomena during the Electro-Deposition of Metals (Ueberschreitungserscheinungen bei der elektrolytischen Metallabscheidung). T. ERDEY-GRUZ & M. VOLMER (Technische Hochschule, Berlin). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 157, Nov. 1931, pages 182-187.

Irregularities in current-voltage curves plotted during the electro-deposition of metals upon indifferent electrodes of foreign carrier materials are ascribed to over-saturation phenomena. The metals experimented with are Cd, Pb, Bi, Cu, and Ag which were deposited on electrodes of Pt, Ta, Au and, in some cases on C. EF (7)

On a New Electro-Chemical Method in Radio-Chemistry (Ein neuartiges elektrochemisches Verfahren der Radiochemie). O. ERBACHER (Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 154, Sept. 1931, pages 142-149.

A new method of electro-depositing polonium and the radio-active isotopes of bismuth (radium E and thorium C) on platinum electrodes loaded with hydrogen is given and the advantages of the deposition on a noble metal carrier are pointed out. EF (7)

Electrolytic Over-Voltages on Metals (Zur Frage der elektrolytischen Metallüberspannung). T. ERDEY-GRUZ & M. VOLMER (Technische Hochschule, Berlin). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 157, Nov. 1931, pages 165-181.

The investigators carried out experiments with the object of clearing up the phenomena connected with the chemical polarization, or the metal over-voltage as designated by the authors. EF (7)

The Deposition Potentials of Nickel (Die Abscheidungspotentiale des Nickels). F. FOERSTER & K. GEORGI (Technische Hochschule, Dresden). *Zeitschrift für physikalische Chemie,* Bodenstein Festband, 1931, pages 453-467.

When electro-depositing the metals of the iron group from the solutions of their simple salts, a strong polarization effect occurs at the cathode. The logarithmic course of the current-density/potential curves disclosed the reaction to be a "checked" one. Recent investigation of Gladstone (*Journal Chemical Society,* London, 1926, page 2887) on the polarization phenomena led to the conclusion that the Ni-deposition only starts at a definite equilibrium potential materially different from the cathode-potential and thence, without any retardation. The authors present evidence to prove theoretically and experimentally that Gladstone's assumptions are erroneous. EF (7)

Electrochemistry, Principles and Practice. C. J. BROCKMAN. Van Nostrand, New York, 1931. Cloth, 6 x 9½ inches, 348 pages. Price $4.00.

This is one of a series of "Industrial Chemical Monographs." The preface states that the volume is aimed to present electrochemistry in not too technical a fashion, to "the chemist, plant manager and the fringe of business men who are not adepts with electrochemical manipulations; yet it is to be hoped that the scientific value of the work will not be lost to the virtuosi of electrochemistry." The volume turns out to be a rather elementary text book of the usual type, with the usual brief descriptions of processes, cells, furnaces, etc., and very little reference to principles. Little distinction is made between successful processes and those that are obsolete, and while the bulk of the information naturally is correct, not all of it may safely be taken as such. Plating or electro-winning of Cu, Ni, Zn, Cr, Pb, Sn, Fe, Cd, Co, Ag, Au, Al, Mg, Na, Ca, Ce, Be has attention under electrolysis, and the usual topics on per-salts Cl, NaOCl, $NaClO_3$, O_3, NO_2, on primary and secondary batteries, on CaC_2, SiC, graphite, Al_2O_3, CS_2, P, Zn by distillation are covered, and brief comments made on furnaces for steel and brass. Ferro alloy manufacture is not touched upon. Copious references only partly redeem the book from the charge of giving each topic too brief treatment to be sufficiently informative. For example, the section of phosphorous and phosphoric acid tells next to nothing, although it states that "concentrated fertilizers are gaining more notoriety each year." It is stated that the size of electric furnaces may increase now that the Söderberg electrode is developed, but no inkling is given as to what the electrode is like. In reference to large furnaces, it is said that the "40 ton furnace unit contains 4 separate 3-phase circuits which do not seem to get mixed up by stray current circuits." On the whole, it is a mediocre book from every point of view, but may serve as an introduction to the subject. H. W. Gillett (7) -B-

Industrial Electrochemistry. C. L. MANTELL. McGraw-Hill Book Co., New York, 1931. Cloth, 6 x 9½ inches, 528 pages. Price $5.00.

A text book for chemical engineering courses, designed also as a work of reference. The principles of electrolysis are given in 60 pages. Hydrogen ion concentration and chemical reactions, such as preparation of per-salts, are next discussed, the electrolytic theory of corrosion is given 4 pages, electro-osmose and cataphoresis, 6. Then follow brief discussions of primary and secondary batteries and rectifiers.

Electroplating, refining, forming and winning receive more extended treatment, 110 pages. Good balance is maintained, the older processes such as nickel plating and copper refining and the newer ones such as chromium plating and the winning of zinc being treated at about the same length. The electrolysis of alkali halides and the production of hydrogen and oxygen complete the discussion of aqueous electrochemistry. The electrolysis of fused salts covers 150 pages, dealing with Al, Mg, Be, Na, Ca, Li, Ce and with Pb alloys. Electrothermics has 85 pages, dealing with metal melting, ferro alloys, carbide and cyanamid, SiC, fused Al_2O_3, and SiO_2, graphite, CS_2, H_3PO_4 and P. The discussion of electric iron-smelting furnaces usually found in treatises on electrothermics is absent, presumably as of too little interest, under American conditions, to deserve space. While many defunct types of steel and brass-melting furnaces are mentioned briefly, care is taken to indicate which ones are obsolete or practically so. On the other hand, high-frequency melting scarcely seems to get as much space as its importance deserves. The section on steel and brass melting and that on ferro alloys is more of a description of furnaces than of the high-temperature chemistry made possible by the furnaces. The metallurgist would have welcomed, and a text book of chemical engineering might well have contained, some discussion of acid and basic electric steel slag practice, for example, but the author confines his chemistry to more simple cases. The reader will hardly gather that electric steel foundry practice is essentially acid practice. Silicon as a reducer in ferro-alloy smelting is casually mentioned, but its importance not brought out. The refining step in the production of low carbon ferro-alloys is scarcely dealt with. The metallurgy of the book is somewhat skimped, and few references to important literature along metallurgical lines are included, though well-selected references are given on some other branches of electrochemistry.

Electrical discharges in gases, electronics, electrostatic precipitation, ozone and nitrogen fixation are briefly treated, as are materials of construction for electrolytic and electrothermic apparatus (electrodes receiving most attention), power generation and economics. The book ends with the usual tables. To condense so much into so little space, to give so much accurate and up-to-date information and so little near mis-information from ill-advised brief side comments that are only half-truths, is quite an achievement. It is decidedly above the usual text-book level. One would have liked to see fuller treatment of principles, especially in the metallurgical sections, even at the expense of space devoted to description of equipment, but perhaps that had better be made the subject of another book, for which there is still room. H. W. Gillett (7)-B-

Electroplating (7a)

Chromium Plating. (Cromatura elettrolitica.) O. MACCHIA. Ulrico Hoepli, Milan, 1932. Paper, 6⅛ x 9½ inches, 483 pages. Price 50 Lira.

A very complete exposition of the subject, profusely illustrated. Many of the illustrations are from American sources, and for both theory and practice, constant reference is made to the writings of Sargent, Blum and Schneidewind. One gathers that Macchia finds the basis for successful commercial chromium plating fully covered in the work of Sargent and of Blum, even though others have alleged that these were laboratory workers only. The history of Cr plating, the properties of the coating, suitable plating baths, analytical and control methods for the solution, current efficiency, bath conductivity, limits for bright plating, throwing power, testing of deposits, discussion of the theory involved, the dangers to health and their avoidance, anodes, and equipment and technique for commercial plating are all discussed in detail. Abstracts of some 190 technical articles and patents are included. The book is thoroughly indexed. A large table showing thickness of deposit per hour at various current efficiencies and current densities is included. The book is decidedly up to date, and probably more complete than any other so far published between a single pair of covers. Although it is in Italian, anyone knowing something about chromium plating and having a reading knowledge of Spanish or French can make it out fairly readily with occasional reference to an Italian dictionary. Most of the important information is elsewhere available in English, but scattered. It is collected here into convenient compass.

H. W. Gillett (7a) -B-

Theory of Chromium Deposition. R. J. PIERSOL. *Metal Cleaning & Finishing,* Vol. 3, Mar. 1931, pages 207-214.

The electrophysics of the ionic currents in chromic acid and the effects of osmotic pressure on the cathode and anode in the chromium solution are explained and compared with previous theories. The substance of the theory of chromium plating as offered by the author is that the chromium products formed by the partial reduction of chromic acid are insoluble and, therefore, do not decompose into ions. They may combine with chromic acid to form colloidal chromium dichromate, $Cr(HCrO_4)_3$, which is not ionized, either. The addition of sulphuric acid permits its chemical reaction with chromium dichromate under formation of $Cr_2(SO_4)_3$, and the liberation of the chromate radical. The chromic sulphate, being soluble, ionized into chromic, Cr^{III} ions and sulphate ions. With the formation of free chromic ions, the deposition of chromium is exactly analogous to other metals which decompose initially into a metal ion. Ha (7a)

Electrodeposition of Iron, Copper and Nickel Alloys. LAWRENCE E. STOUT & CHARLES L. FAUST. *Preprint, Transactions Electrochemical Society,* Vol. 61, Apr. 1932, pages 1-22.

The cathode process in the electrodeposition of Cu-Fe-Ni alloys from the cyanide bath is controlled by the metal and hydrogen overvoltages, both of which depend upon the concentration polarization of the solution as indicated by the rule of mixtures, which states that in an electrolyte containing a common ion, the degree of dissociation depends solely upon the concentration of the common ion and is independent of all unlike ions. This explains the inhibitive effect upon the ionization of Cu^{+}, Fe^{++}, Ni^{++}, etc., from their complex cyanides by the presence of one with another, and also by the presence of free KCN or NaCN. This inhibitive effect upon ionization, together with a variation in the initial concentration of the salts in solution, raises the over-voltage of each metal sufficiently high to be near each other in value so that a simultaneous deposition of the metals is obtained in the form of an alloy. The degree of dissociation of various metal ions in a mixture of their salts, according to the established rule, is determined by the product of the valences of the 2 ions in solution, wherein those salts of lower valence product have greater dissociation. Hence, in a mixture of complex cyanides of Cu, Fe and Ni, which dissociate in the following manner:

$$K_3Cu(CN)_4 \rightleftarrows 3K^{+} + Cu(CN)_4^{\equiv} \rightleftarrows Cu^{+} + 4(CN)^{-}$$
$$K_2Ni(CN)_4 \rightleftarrows 2K^{+} + Ni(CN)_4^{=} \rightleftarrows Ni^{++} + 4(CN)^{-}$$
$$K_4Fe(CN)_6 \rightleftarrows 4K^{+} + Fe(CN)_6^{\equiv} \rightleftarrows Fe^{++} + 6(CN)^{-}$$

would equally favor ionization of $Cu+$ and $Ni++$ at the expense of $Fe++$. In actual plating, however, the Cu deposits more readily than Ni, because of a secondary reaction at the cathode:

$$Ni(CN)_4^{=} \rightleftarrows Ni^{++} + 4(CN)^{-}$$
$$Ni^{++} + (CN)^{-} \rightleftarrows NiCN^{+}$$
$$2NiCN^{+} + 3\theta \rightarrow Ni + NiCN + (CN)^{-}$$
$$NiCN + 2KCN \rightarrow K_2Ni(CN)_3$$

which interferes with Ni deposition. The presence of tartrate as a buffer in the complex cyanide bath is essential to Fe deposition. Extensive experiment work with sulphate bath as well as cyanide bath variously buffed with tartrates, boro-tartrates, citrates and boro-citrates, verifies the view that deposition of Cu, Fe and Ni occurs from the cyanides and not from the tartrates of these metals; even if the complex tartrates were initially present, they would have been replaced by the complex cyanides. LCP (7a)

Tests for Quality of Electroplates. C. L. MANTELL. *Metal Cleaning & Finishing,* Vol. 3, Mar. 1931, pages 189-192, 203-204.

3 kinds of tests are made to determine the quality of electroplated deposits: (1) the specimen is tested for porosity to determine the number of pinholes and cracks in the plating; (2) accelerated tests for corrosion resistance and wear are applied; (3) service tests on service panels are made. The value of these methods is discussed. 7 references. Ha (7a)

Problems in High Current Density Nickel and Chromium Deposition. N. R. LABAN. *Metal Industry,* London, Vol. 39, July 17, 1931, pages 63-64; discussion, July 31, 1931, pages 110-112.

From paper given before the Electroplaters and Depositors Technical Society. Etching of basis metal is necessary for good adhesion of Ni deposit. For Ni, Cu, steels, etc., use anodic sulphuric acid etching, but for brasses use nitric acid. Peculiar to high current density work are (1) inclusions of foreign matter in deposit, overcome by depolarized anodes and good filtering; (2) lack of throwing power, overcome by increasing estimated plating time; (3) contact resistance, reduced by use of spring clips and jigs. The same difficulties are encountered in Cr plating, which shows the faults immediately. Articles which have "missed" should be anodically etched and repolished before re-chrome plating.

A New Method for the Hydrogen-Ion Control of Electroplating Solutions. I. LAIRD NEWELL. *Brass World,* Vol. 28, Jan. 1932, pages 1-2.

A simply constructed inexpensive apparatus sufficiently accurate for plating control is described. The apparatus consists of a slide comparator and a burette similarly supported. The comparator slide of bakelite contains the color standards corresponding with given pH value. The base contains a slot in which the slide can be moved back and forth and holes for the vials of indicator solution, and comparator tubes. WHB (7a)

New Ways to Surface Refining. (Neue Wege der Oberflächenveredelung.) K. ALTMANNSBERGER. *Oberflächentechnik,* Vol. 9, Jan. 19, 1932, page 14.

A few prescriptions are given to obtain decorative effects on electroplated surfaces; on Cr plated surfaces mat and glossy areas and change of the bluish-white tinge of this metal; an electrolytic method to obtain a yellowish hue of silver plating; a method of mat-pickling of brass and then Ni-plating. Ha (7a)

The Present Status of Plating on Zinc. E. A. ANDERSON. *Metal Cleaning & Finishing,* Vol. 3, Feb. 1931, page 101-104.

A complete description of the electrodeposition of Ni and Cr on Zn as it is often employed for die castings and the treatment of Zn. Solutions for cleaning are given. A good nickel bath is the following: water, 1 gal.; single nickel salts, 10 oz.; anhydrous sodium sulphate, 15 oz.; ammonium chloride 1.75 oz.; boric acid, 2 oz. No method for producing bright chromium coatings directly on Zn is known at present. Ha (7a)

Experimental Plating Cell. T. F. HAWLEY. *Metal Industry,* New York, Vol. 29, Nov. 1931, page 480.

For use in preliminary studies of regular plating procedure, such as control of current density, strength of solution, effect of temperature, an experimental plating cell can be easily made from 3 pieces of paraffined poplar board which form the sides and bottom and the two ends are formed by clamping in place metallic electrodes using rubber gaskets.

Layout of a Small Electro Zincing Department. JOHN L. EVERHART. *Metal Industry,* New York, Vol. 29, Dec. 1931, pages 527-528.

A general description is given of the arrangement of a plant for zinc plating 150 dozen yokes and 80 lbs. ferrules per day. PRK (7a)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Metal-Lined Steel Tubing Made by New Process. *Brass World,* Vol. 27, July 1931, page 160.

Steel tubing lined with various non-ferrous metals suitable for a variety of uses is made by the Detroit Seamless Steel Tube Co., Detroit, Mich. A metal-lined tube is supplied with a very perfect bond between the outer and inner shells, showing no evidence of possible separation. The centrifugal casting of the lining metal provides a superior texture. Linings already successfully applied are bronze, brass, Sn, and almost any alloy or non-ferrous metal. WHB (8)

Status of the Welded-On Overlay. M. CATLIN SMITH. *Steel,* Vol. 88, June 18, 1931, pages 39-42.

A review of the development of hard-facing or welded-on overlay by means of electric or acetylene heating; good prospect is seen for this process. Ha (8)

Surface Treatment of Materials. (Oberflächenbehandlung der Werkstoffe.) W. WIEDERHOLT. *Maschinenbau,* Vol. 10, Feb. 19, 1931, pages 132-134.

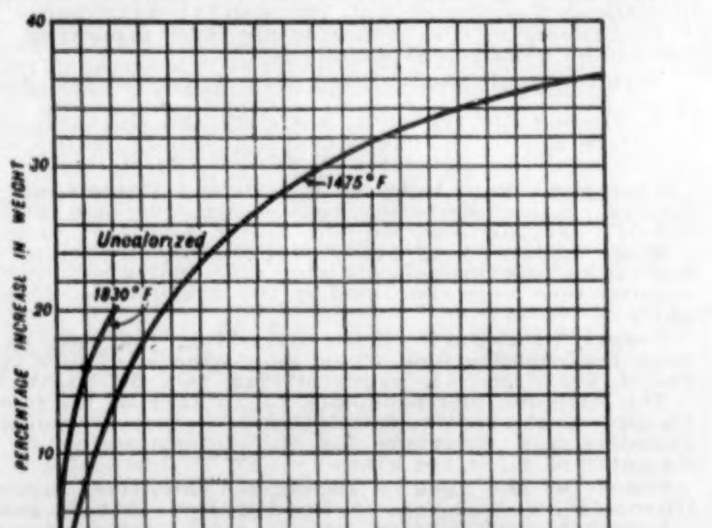
A short, concise review of the field of surface treatment is made, including both the mechanical and chemical methods. The surfaces may be covered by the effects of chemical treatment, by the use of paints and by metallic coatings. The variety of behavior and range of usefulness of each, as well as the possibilities for improvement and the necessity for coöperative research is discussed. MAB (8)

Aluminum and Its Alloys. *Electrician,* Vol. 106, May 29, 1931, page 782.

The principles of surface treatment by electrochemical methods and processes for various uses are discussed. The available methods of surface treatment may be divided broadly into 2 main categories (mechanical and chemical) with the latter subdivided into pure chemical, physicochemical and electrochemical. The treatments may serve as protection, decoration, or insulation. Various forms of anodic oxidation are outlined. Al presents special difficulties for electro-deposition, but the difficulty of non-adherent film can be overcome by: (1) coating the metal with a fast-adhering coating of a second metal (usually Cd or Zn); (2) working with a very big current; (3) rendering the metal passive. The last method is most commonly used. Some special methods are pointed out. An Al surface may be prepared for electrodeposition by electrolytic deposition of an amalgam. A suitable bath contains: 10 gm. zinc chloride, 5 gm. mercuric nitrate, 200 gm. caustic soda, 200 gm. sodamide, 40 gm. stannous chloride and 10 gm. caustic potash to 20 liters of water. The voltage is 1.5 and the time a few minutes. For Al plating, the bath must be well buffered, contain a suitable addition agent and have a definite pH value maintained. Ni, Cu, Cd and Zn are plated directly on Al and combinations of Cd-Cr, Ni-Cu-Ni or brass, Ag, Au, Pb, Co, etc., with an intermediate plating of one of the former metals, usually Ni or Cu. Ni is plated on a roughened surface; Cu, Cd and Zn on a smooth surface. Several baths for Ni plating solutions for Al are given, as well as for Zn and Cd. Soft rubber may be fixed directly to Al by vulcanization. Coloring, and coppering of Al, and blackening are touched upon. WHB (8)

Calorising. *Engineer,* Vol. 152, Aug. 7, 1931, page 139.

Brief discussion of the process of alloying the surface of steel with Al. A photomicrograph is given which shows the normal steel structure merging at the surface into an alloy with the Al and finally a thin film of aluminum oxide forming a protective coating on the outside. A graph is given showing the resistance of calorized steel as compared with untreated metal to scaling at high temperatures. LFM (8)



OXIDATION TESTS

The Surface Treatment of Aluminium and Its Alloys. *Metal Industry,* London, Vol. 38, May 29, 1931, pages 555-558; June 26, 1931, pages 649-651.

This is *Intelligence Memorandum* No. 16 of the *British Aluminum Company, Ltd.* A detailed description is given of the mechanical, chemical, and electrochemical methods of surface treatment of Al and its alloys for protective and decorative purposes. PRK (8)

Zinc Coating Protects Hudson River Bridge Cables. *Metal Industry,* N. Y., Vol. 29, May 1931, page 210.

Special apparatus was used to hot galvanize twice the 29,000 tons of wire, 0.192 in. in diameter, before it was "spun" into the bridge cable. PRK (8)

INDUSTRIAL USES & APPLICATIONS (9)

Lead in Form Of Continuous Mold Used in Curing Rubber. *American Metal Market*, Vol. 38, Apr. 8, 1931, page 3.
Reprint of same by James L. Cutler in *The Circle*, National Lead Co. Bulletin, Apr. 1931. DTR (9)

Honing Cylinder Blocks, Barnes Drill Co. *Abrasive Industry*, Vol. 12, Nov. 1931, page 30.
An all-geared, hydraulically operated honing machine is described and illustrated. It is designed especially for economical finishing of automobile engine cylinder blocks. WAT (9)

Aluminum-Alloy Motor Launch. *Engineering*, Vol. 131, Apr. 24, 1931, page 542.
Describes launch built by the Birmingham Aluminum Casting Company, using Birmabright Al alloy. This is a high-Al alloy containing some Mg but very little Si. It is highly corrosion-resistant and has excellent physical properties. When cast in sand, the alloy has a clean, bright finish and is free from porosity. LFM (9)

Alloy Steels Important in Valve Manufacture. A. H. Allen. *Iron Trade Review*, Vol. 86 Feb. 20, 1930, pages 39-42, 47.
Describes practice of Thompson Products Inc., Cleveland. Si-Cr steel containing 3-4%C and 7-10% Cr is used in automotive exhaust valves. Intake valves are made from a special steel, S.A.E. steel 3140, and a few from 6150. An austenitic steel known as C.N.S. steel, with a Cr content of 11-15%, Ni, 7-9%, and Si, 2-3%, is used for most aircraft exhaust valves. It is corrosion resistant, has high strength at heat and will not harden. S.A.E. 71360, a high W steel, is used for aircraft intake valves and some exhaust valves. A Co-Cr steel, PRK-33, is used for a few aircraft exhaust valves. It is heat resistant and has high tensile strength and good impact values. Outlines the various operations in the manufacture of valves. MS (9)

Cleveland's Results From Rail Wear Studies. Howard H. George, *Electric Traction*, Vol. 27, Nov. 1931, pages 540-541.
The use of intermediate manganese steel rails at car shops and other points of excessive wear by the Cleveland Railway Company has been justified through rail wear studies. The results show that the rate of vertical wear per 100,000 wheel passes between stops and at the stop are identical, a condition which is very desirous. No difficulty has been encountered in welding this material; both seam welds and Thermit welds have shown no breaks to date (since Aug. 1928). The company feels that the increase rail cost of 7½% has been well worth while. Composition of material not given. WAT (9)

Aluminum Foil as a Basis of Insulation. Max Breitung. *Refrigerating Engineer*, Vol. 22, July 1931, pages 11-14.
Al foil insulation is built up by applying successive layers of foil with spacings of approximately 1/3 in. The foil may be in flat sheets or crumpled to provide irregular surfaces. The foil used is about 0.0003 in. in thickness. Al foil insulation has the advantage of being very light in weight, weighing only 3 oz./ft.^{3} of insulation, while cork and magnesia weigh 10 lbs. and 17 lbs./ft.^{3}, respectively. As an insulation, the crumpled Al foil is equal to cork at low temperature and superior to magnesia at high temperature. Al foil operates as an insulant because of its high reflectivity for radiant heat, about 95% of the radiant heat being reflected. Long exposure of the foil to the atmosphere even at high temperature did not change the reflectivity. (9)

The Building Spandrel of Cast or Sheet Aluminum alloy. *Engineering News-Record*, Vol. 108, Feb. 11, 1932, pages 216-217.
Discussion of the manufacture and properties of cast aluminum ornamental spandrels. CBJ (9)

Welded Steel Tools. *Edgar Allen News*, Vol. 10, Jan. 1932, page 28.
In these tools the ends, not only the tips of high-speed steel are welded to shanks of a high-grade quality steel, for which method a considerable economy is claimed. Ha (9)

Cast Steel Foundations for Railroad Equipment. Wm. M. Sheehan. *Railway Mechanical Engineer*, Vol. 105, Dec. 1931, pages 573-577, 584; *Steel Founder*, Vol. 2, Jan.-Feb. 1932, pages 18-23.
Many parts of very bulky proportions, as bottoms of tender tanks, locomotive beds, etc., are illustrated. Problems of maintenance were simplified by the introduction of cast steel parts. Ha (9)

Copper Tubes in Domestic Plumbing. (Le tube en cuivre dans les canalisations d'eau domestiques.) *Cuivre et Laiton*, Vol. 4, 1931, Dec. 15, pages 543-549, Dec. 30, pages 567-574.
The hygienic and economic advantages of Cu pipes over Pb pipe in the water installation of houses are pointed out; formulas and diagrams for the determination of proper diameter of pipes are given. Ha (9)

Report of the Springs Research Committee. *Department of Scientific & Industrial Research*, London, Nov. 1931, 75 pages.
Research work was carried out with particular reference to properties of spring materials, design of springs, and method of suspension of vehicles. The points investigated were the best distribution of material in the spring and the stresses to be allowed in the material, the various methods of transmitting the driving torque and their effect on the spring, the methods of attachment of the spring to the chassis, the effect of nip on the safe stress to which the material could be subjected, the use of rebound plates, resilient stoppers, and reversed camber. The materials used, the test methods applied are described in detail; as a general conclusion it could be stated that all steels investigated can be treated so as to give very high intrinsic properties, yet these high properties are not realized in the spring material as ordinarily manufactured and used. This surprising discrepancy is due to the fact that, owing to development of surface weaknesses as the result of heat-treatment or other causes, the intrinsic properties are never fully realized either in spiral springs or in plates. The influence of the weak surface layer seems to be sufficient to nullify to a great extent the advantages gained by the use of properly treated high-grade spring steels. The general theory of designing springs is developed; appendices with bibliographies on springs and a list of published papers on research in this field is added. Ha (9)

Copper Roofs. (Les Toitures en Cuivre.) *Cuivre et Laiton*, Vol. 4, Nov. 30, 1931, pages 517-530.
The various types of roofs as employed for buildings and other edifices of a more formal character, their construction details and materials are described in detail; a solution for producing an artificial patina is given, and a number of important buildings with copper roofs in America and Europe enumerated. Ha (9)

Copper and Wine. (Le Cuivre et le Vin.) *Cuivre et Laiton*, Vol. 4, Dec. 15, 1931, pages 553-554.
The important part which copper has in the modern treatment of grapes and wine is pointed out; copper sulphate serves to destroy injurious insects. Copper apparatus and tubing are used in pressing, fermenting the juice, and treating the finished product. Ha (9)

Thallium. *Chemicals*, Vol. 36, Dec. 1931, page 25.
Sources, properties and uses of Th are given. Because of their high refracting power, Th compounds are used in the manufacture of certain kinds of optical glass. WAT (9)

Alloy 43 in Architecture. (Legierung 43 in der Architektur.) *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 13, 1931, page 882.
This is an Al-Si alloy of silver white color which can be cast very easily; it has a tensile strength of 14 kg./mm^2 and a very high resistance to corrosion. It is used particularly for ornaments, frames, window sashes and sills, etc., for architectural purposes. Ha (9)

Bomb of Chrome-Nickel Steel withstands High-Pressure. *Steel*, Vol. 89, Aug. 27, 1931, page 33.
In an oil cracking process, bombs are used for heating a heavy crude oil to 850°-950° F. for the extraction of commercial gasoline. The bomb is of forged chrome-nickel steel and withstands a pressure of 1000 lbs. Ha (9)

Mirrors and Reflectors. *Metal Progress*, Vol. 19, May 1931, pages 92-96.
Description of silvering methods and the history of mirror making. WLC (9)

Nickel Cast Iron in the Automobile Industry. *Foundry Trade Journal*, Vol. 45, Oct. 29, 1931, pages 267-271.
An article, accompanied by 8 figures and 1 table, showing suggested compositions of castings for the automobile industry. A brief discussion is introduced of the value of nickel (1) in equalizing the structure and thus minimizing the variations between thick and thin sections in a casting, (2) in improving machinability, (3) in refining and condensing the iron in thick sections, (4) in eliminating porosity, (5) in inducing heat- and corrosion-resistant properties when present in sufficiently high proportions together with other elements, (6) in improving resistance to wear and abrasion, (7) in giving to iron qualities which make it capable of improvement by heat treatment, and (8) in producing high expansion castings to work in conjunction with aluminum alloys. This is followed by a description of numerous instances where nickel cast iron has proved of value in the automobile industry. OWE (9)

Aluminum Cable Specified. *American Metal Market*, Vol. 38, Apr. 1, 1931, page 14.
Reprinted from *Metal Bulletin*, London. Total of 12,000 miles steel-cored Al cables and earth wire specified for main lines, or total of 8,500 tons. Equal quantity of secondary low voltage lines. DTR (9)

Hafnium Has Few Uses. *American Metal Market*, Vol. 38, May 28, 1931, page 5.
Reprinted from *U. S. Bureau of Mines Information Circular* 6457, "Hafnium." High melting point and electronic emissivity to be used in radio tubes and incandescent electric lamp filaments, and for cathode surfaces of X-ray tubes and rectifiers. DTR (9)

Platinum Has No Substitutes For Many Of Its Uses. *American Metal Market*, Vol. 38, Apr. 8, 1931, pages 2-3.
Reprinted from *Information Circular* 6389, "Platinum," *U. S. Bureau of Mines*. Covers entire scope of uses of Pt and allied metals. Some substitutes in electrical industry for Pt, and in surgical dental instruments Pt replaced by Stellite and other alloys of Cr, W, and Co. DTR (9)

New Ways in Building Pipe Lines (Neue Wege im Rohrleitungsbau). H. Juergens. *Autogene Metallbearbeitung*, Vol. 24, Oct. 1, 1931, pages 291-293.
Notes the advantages offered by welding and cutting in the building of gas lines and water lines for building up new city districts and settlements. A comparison of costs shows considerable savings against other methods. Ha (9)

Pipe Line Review Notes. W. S. Johnston. *American Gas Journal*, Vol. 136, Feb. 1932, page 31-32.
More than 9000 miles of natural gas lines were laid in 1931 costing approximately $450,000,000. The largest line, 975 miles long, cost on an average of $75,000 per mile. 220,000 tons of 24-inch diameter steel pipe were used. Line crosses portions of the states of Texas, Oklahoma, Kansas, Nebraska, Iowa and Illinois. Pipe was welded and used sleeve couplings at pre-determined intervals to provide for expansion. Exterior of pipe was coated with non-corrosive paint. In some soil conditions the pipe was wrapped with especially impregnated felt and then sealed with hot asphalt. CBJ (9)

Automobile Body Sheets; Properties of Steel for Body Building. R. O. Griffis. *S. A. E. Journal*, Vol. 30, Jan. 1932, pages 27-28.
The requirements of sheets for producing automobile bodies are that they can be formed without breaking, necking down, wrinkling or buckling, and that the surface of the finished part shall be free from defects which would cause excessive finishing costs. Automobile body sheets are made today by 3 principal methods: the hand-operated mill, the continuous hot-mill practice, and the continuous cold-mill process, working either on coils or single sheets. Methods for testing the quality of the sheet are described. The factors which are at present beyond the absolute control of the sheet manufacturer are ingot segregation, slight chemical variations between different heats of steel, unavoidable variations in normalizing temperatures or cooling rates, and variations in items like gage and surface conditions. Suggestions for coöperation of shops are offered. Ha (9)

HEAT TREATMENT (10)

Improved Equipment Facilitates Heat Treatment of Bolts. A. H. Allen. *Steel,* Vol. 88, Feb. 26, 1931, pages 31-34.

A rather complete account of the modern heat treating department in the bolt and nut plant of the Lamson and Sessions Co., Cleveland, Ohio. JN (10)

A Contribution to the Question of Inner Stresses in Steel due to Heat Treatment. (Beitrag zur Frage der Eigenspannungen im Stahl durch Wärmebehandlung.) Hans Bühler. *Mitteilungen aus dem Forschungs-Institut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund,* Vol. 2, No. 8, 1931, pages 149-192; *Archiv für Eisenhüttenwesen,* Vol. 5, Feb. 1932, pages 413-418.

The concept of "inner stresses" is defined as that state which is produced in a body in any manner without the effect of an exterior force. Inner stresses occur as soon as non-uniform changes of volume or shape occur in a body over its section. These changes can be of chemical origin, a consequence of non-uniform chemical composition; of mechanical origin as consequence of forging, rolling, drawing, etc., of thermal origin as heating or cooling stresses; of physico-chemical origin as consequence of a transformation of structure with change of volume. The last two are the principal causes in the heat treatment of steel and are thoroughly investigated. From the test results, for the details of which the paper must be referred to, it follows that pure heat stresses caused by water quenching of C steels below temperatures of point A_1, increase gradually up to 450° C. then considerably. Tangential stresses have a similar course as the longitudinal stresses. Inner stresses can be removed almost entirely by annealing; up to 300° C. they are reduced considerably, and by annealing up to 600° C. also the maximum stresses are reduced to less than 10 kg./mm.^{2} Numerous diagrams and curves illustrate the test results and a list of 9 bibliographic references is added. DTR+Ha (10)

Heating and Treating Locomotive Forgings. *Metal Progress,* Vol. 19, Apr. 1931, pages 45-48.

A release of the Recommended Practice Committee A.S.S.T. gives the recommended methods of heating for forging, forging annealing, normalizing and tempering. Times and temperatures for various steels and sizes are recommended. WLC (10)

Decarburizing Action of Fused Salt Bath. A. Seuthe & E. Schulz. *Iron Age,* Vol. 128, Dec. 17, 1931, page 1554.

An abstract translation of an article in *Stahl und Eisen,* Vol. 51, June 25, 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 13. VSP (10)

Difficulties of Heat Treating Tubular Axles are Overcome by Special Design of Normalizing and Hardening Furnace. I. W. Spring (Logan Gear Co.). *Automotive Industries,* Vol. 65, Aug. 1931, pages 241, 244; *American Gas Journal,* Vol. 135, Sept. 1931, pages 56-57.

Special furnace is continuous-chain-conveyor type, gas fired, with capacity of 50 axles/hr, from cold to normalizing temperature of 1650° F. and hardening temperature of 1470° F. Normalizing furnace inside 13 ft., hardening unit 9 ft., and cooling chamber between units 6 ft. long. Description of normalizing, hardening, quenching, pickling and drawing is given. CBJ+DTR (10)

Heat Treatment of Small Tools with Modern Equipment and Technique. David A. Nemser (Pratt & Whitney Co.). *Metal Progress,* Vol. 21, Feb. 1932, pages 23-28.

Considerable advance has been made in recent years in the control of the art of hardening both by furnace manufacturers and metallurgists. The determination of the physical requirements of the tool material and the selection of commercial steels is followed by study of the ability to duplicate quality in mass production and facilities necessary. The author amplifies the statement that cost of such facilities is secondary to their efficiency. Furnaces for the treatment of small tools of water hardening tool steel, oil hardening tool steel, and high speed tool steel are described. Considerable space is devoted to the treatment of high speed steel and furnaces used. Tongs and other fixtures to facilitate quality and uniformity of work are discussed. Surface finishing of tools and inspection methods are described. WLC (10)

Decarburization of Steel at Heat-Treating Temperatures. *Gas Journal,* Vol. 195, July 15, 1931, page 149.

Reviews the Bulletin put out by the Department of Engineering Research of the University of Michigan under the auspices of the Committee on Industrial Gas Research of the American Gas Association in 1928 for a remedy for the decarburization of steel in certain hardening operations in which the maximum surface hardness is required. The paper is written by W. E. Jominy, who points out that decarburization has often been the cause of excessive wear and the early failure of parts in practice. The influence of gases found in the products of combustion of manufactured gas, the effect of changes of pressure, of rate of flow of the gases, and of the atmosphere were investigated. H has the strongest decarburizing action of gases in an open-fired furnace. Carbon dioxide is the second most serious gas. N, if absolutely pure, causes no decarburization, though ordinary nitrogen does. Steam causes a very small amount after 5 hours' heating at 1450° F. and air has very little under the same conditions. Variations in pressure from ½ to 1½ atmospheres have practically no effect on decarburization. The stronger the oxidizing furnace atmosphere as measured by the percentage of free O, the less the tendency to carburize, and conversely. Elimination of decarburization and of scaling can be accomplished by heating in pure N. 3 main methods are given: (a) heating in a so-called neutral or slightly oxidizing furnace atmosphere; (b) a hypereutectoid case will minimize softness if the steel has been carburized; (c) formation of certain types of scale on the surface will prevent decarburization. Short periods of exposure may be used to minimize the decarburizing effects. Steels of certain composition may decarburize more rapidly than others. MAB (10)

Case Hardening & Nitrogen Hardening (10c)

Temperature Control a Feature of New Nitriding Furnace. James H. Knapp. *Steel,* Vol. 88, Feb. 19, 1931, pages 38, 40.

Describes new type of gas-fired furnace, the Convecto, especially adapted for continued low temperature operation. The temperature of the furnace is kept below the flame temperature of the fuel by means of a regulated stream of cold air which mixes with the gases of combustion around the flame. Also, a uniform and rapid circulation of hot gases is maintained throughout the furnace chamber. It is claimed that this furnace can be operated satisfactorily between 300° and 1200° F. with close temperature regulation and uniform heat distribution. JN (10c)

New Carburizing Bath Affords Increase in Depth of Case. E. C. Moffett. *Steel,* Vol. 88, Mar. 12, 1931, pages 38-42.

The usual sodium cyanide bath gives a case of about 0.01 in. thickness. By adding an activating ingredient, calcium cyanide, cases from 0.005 to 0.032 in. at carburizing temperatures of 1650° to 1700 ° F. can be produced in 3 hours. The procedure is described more in detail and curves showing the improvement produced. Ha (10c)

Hardness Induced by Nitriding. Marcus A. Grossmann. *Foundry Trade Journal,* Vol. 45, Oct. 22, 1931, page 259.

Extended abstract of paper which was read at a meeting of the American Iron & Steel Institute. See "An Appraisal of Nitriding," *Metals & Alloys,* Vol. 2, Nov. 1931, page 264. OWE (10c)

Is the Carburizing Process a Success? E. F. Lake. *Heat Treating & Forging,* Vol. 17, May 1931, pages 455-459.

The author believes that frequently properly heat-treated alloyed steels give better service and even make a saving in material for parts under heavy fatigue stresses possible. The carburizing process often does not give uniformity of grain and causes inner stresses leading to microscopic cracks. Ha (10c)

Influence of High Frequency Electrical Oscillations on the Properties of Metals and Alloys. Julius Grant. *Metal Industry, London,* Vol. 39, Aug. 28, 1931, page 205.

The diffusion of chromium and of carbon in iron is speeded up by the high frequency vibrations set up by electromagnetic oscillations. The degree of nitriding hardness can also be increased. PRK (10c)

Quenching (10d)

An Investigation of Martensitic Quenching and a Hardening Thermal Treatment for Cast Irons (Recherches sur la trempe martensitique et le traitement thermique durcissant des fontes). Leon Guillet, Jean Galibourg & Marcel Ballay. *Revue de Métallurgie,* Vol. 28, Nov. 1931, pages 581-597.

The advantages of white cast iron castings can be fully realized when castings leave the mold in martensitic state, softened for machining by a proper treatment and rehardened again by some very mild treatment which will not introduce any cracking. The same results can be obtained using gray iron to which some alloying elements are added and which is heat treated after machining. The present paper is the result of a very extensive investigation dealing largely with the influence of Ni addition on hardening properties of cast iron. Critical points, necessary quenching rates and physical properties after heat treatment of several hundred different irons were determined. Quenching decreases all mechanical characteristics with exception of hardness, but drawing after it increases shear resistance by about 50% and bending value by 10%. In selection of the desired composition, one must have a gray iron, which, the carbon content being given, specifies the minimum amount of Si. Quenching tendency is obtained by addition of Ni. Its amount depends on the permissible cooling speed. For oil quenching, 1.5-2% are sufficient. For air quenching, 4 or 5% are required, depending on the thickness of the casting. In the majority of cases Si can be around 1%. The paper is illustrated with 41 curves and tables and 11 photomicrographs. JDG (10d)

Effect of the Quenching Temperature on the Physical Properties of KA2S. John L. Everhart. *Wire & Wire Products,* Vol. 7, Jan. 1932, pages 5-7.

The tests were made with the stainless steel KA2S of the composition 0.065% C, 0.54% Si, 16.96% Cr, and 8.93% Ni. The samples were heated up to different temperatures and quenched in cold water. The following table shows the results:

Quenching Temp. °F	Hardness Rockwell	Yield Point lbs./in.^{2}	Tensile Strength lbs./in.^{2}	Elong. % in 2"	Reduction of Area %
1850	B-74	28,000	94,000	62	75
1950	B-78	29,500	95,000	60	72
2050	B-78	30,000	96,000	58	71
2150	B-73	27,000	89,500	62	68
2300	B-70	25,500	84,000	66	72

The results indicate that although the heat treatment of the austenitic alloys is a very simple process as compared with some other alloys, the quenching temperature is a very important factor in obtaining suitable physical properties and grain size. Ha (10d)

Does Quenching Stiffen a Spring? *Metal Progress,* Vol. 18, Dec. 1930, pages 90, 116.

A discussion by A. L. Boegehold, (General Motors, Detroit) and F. P. Zimmerli, (Barnes, Gibson-Raymond, Inc., Detroit) of an editorial article in Oct. *Metal Progress,* regarding the effect of quenching after coiling heat treated wire into a spring. WLC (10d)

Quenching Cracks (Les tapures de trempe). A. Sourdillon. *Revue de Métallurgie,* Vol. 28, Nov. 1931, pages 631-638.

A summary of the well known factors leading to cracking of steel on quenching. Recommendation is made to replace, where possible, high carbon steels with alloy steels containing less carbon. For important parts, the use of plain carbon steel requiring a water quench should be avoided. JDG (10d)

Drawing (10e)

A Contribution to the Study of Tempering Quenched Steels. (Contribution a l'etude du revenu des aciers trempes.) Pierre Chevenard & Albert Portevin. *Revue de Métallurgie*, Vol. 28, Aug. 1931, pages 417-425; Sept. 1931, pages 503-517; Oct. 1931, pages 546-556; *Revue Universelle des Mines*, Series 8, Vol. 6, Nov. 15, 1931, pages 309-315; Dec. 1, pages 391-400; Dec. 15, 1931, pages 443-448.

All complex changes occurring in a metal during thermal treatment can be detected and accurately estimated only by thermo-physical methods. Dilatometer records the weakest and slowest reactions on the diagrams which are easy of interpretation because the aggregates obey the laws of mixtures. 12 steels were investigated dilatometrically, separating the heating and cooling periods by a 7-hr. interval at a constant temperature. The results were checked magnetometrically and under a microscope. High C alloy steels quenched to a fully austenitic state were used as samples with a few exceptions. In Mn steel (1.5% C, 2.05% Mn) the decomposition of austenite occurs in 2 stages: (1) austenite into cementite and less carburized austenite (2) partially decarburized austenite into cementite and α iron. The decomposition of martensite is slower and is accompanied by variations in the distribution of Mn in cementite and α iron segregating in the former. In a Cr steel heated under 330° C., precipitation of cementite with the low Curie point, transformation of γ into α iron and the precipitation of cementite with a high Curie point are observed. The precipitation of proeutectoid cementite preceding or accompanying the formation of troostite is very sharp here. The decomposition of martensite is completed at 350° C. Above 330° C., the precipitation of carbides is faster than the formation of troostite. At the end of the heating interval the austenite which remains undecomposed becomes more abundant and contains less C and Cr, the higher was the temperature of isothermic heating so that, deprived from the stabilizing action of these elements, it cannot return to the room temperature without some profound changes. Cooled from this range, the steel becomes quenched with the formation of secondary martensite. Dilatometer shows it clearly. With 1.25% C and 4.8% Cr, the phenomena are the same as for lower C-Cr steel but are much sharper. On its hardness curve there are 3 distinct maxima at 300°, 400° and 475° C. corresponding to the formation of troostite, precipitation of cementite from austenite and secondary quenching. Quenched from 1180° C., a 1.60% C steel forms a mixture of equal amounts of austenite and martensite. The latter appears after an acid etch as bright needles. From the room temperature to about 150° C. martensite decomposes forming finely divided cementite and martensite less rich in C. This increases its solubility and after an acid etch the martensite appears now as dark needles. From 150° C. upwards the decomposition of austenite into proeutectoid cementite and troostite (a mixture of martensite and cementite) becomes more and more rapid and partially decomposed austenite becomes more corrodible so that acid etch darkens it while leaving martensitic needles bright again. Above 245° C., no more γ iron is present. The steel consists then of 3 martensites: the original, the one formed on decomposition of austenite and martensite of troostite. They all lose their C progressively tending towards sorbite, a mixture of α iron and cementite. To this reaction must be added structural changes such as coalescence of cementite, etc. Drawing above 550° C. causes in this steel the dissociation of cementite into graphite and ferrite. In drawing a quenched 0.8% C steel, the decomposition of austenite is slight and changes in martensite are pronounced. The transformation of austenite into troostite is completed here at 225° C. The rapid increase in hardness at 75° C. is not due here to the decomposition of austenite, which is practically unaffected under 100° C. but to the precipitation of cementite from martensite. Freed from the secondary phenomena of austenite decomposition, the mechanism of martensite decomposition consists in progressive decarburization of α Fe-C solution taking place over a wide temperature range. 72 graphs and 11 photomicrographs are given.
Ha+JDG (10e)

Aging (10f)

Age-Hardening of Titanium-Copper Alloys. (Vergütbare Titan-Kupferlegierungen.) W. Kroll. *Zeitschrift für Metallkunde*, Vol. 23, Jan. 1931, pages 33-34.

Cu-Ti alloys can be melted in air up to 3% Ti, but greater Ti-content leads to formation of titanium nitride. With air excluded (argon) forgeable alloys can be prepared with Ti as high as 6%. A (t-x) constitutional diagram is given up to 25% Ti in which the liquidus and solidus have been experimentally determined. The solid solubility curve is approximated: at 900° C. (the eutectic temp.) the solid solubility is probably 3-4% Ti, at room temperature the solubility is less than 0.56% Ti since this alloy ages. Curves are given for Brinell hardness and tensile strength of Cu-Ti alloys up to 4% Ti immediately after quenching from 850° C. and after 24 hrs. aging at 350° C. In the quenched 3% Ti alloy, the Brinell hardness is 85 and the tensile strength 45 kg./mm.^{2} as compared to 52 and 32 kg./mm.^{2} for pure Cu; aging for 24 hrs. at 850° C. increases these values to 200 and 72 kg./mm.^{2}. Curves are given showing changes in electrical conductivity of alloys up to 3% Ti as a function of aging treatment.
RFM (10f)

Heat Treatment of Highly-stressed Pipe Line Parts. (Ausglühen von hochbeanspruchten Rohrleitungsteilen.) W. Paul. *Die Wärme*, Vol. 54, July 18, 1931, pages 560-562.

By an annealing treatment, which is discussed at length, the aging phenomenon occurring in tubes deformed at ordinary or elevated temperatures, can successfully be overcome.
EF (10f)

The Phase-Theory Basis of Aging of the Duralumin Type in the Ternary System. E. Scheil. *Metallurgia*, Vol. 3, Mar. 1931, pages 177-180, 182.

Translated from *Zeitschrift für Metallkunde*, Vol. 22, Sept. 1930, pages 297-302. See *Metals & Alloys*, Vol. 2, July 1931, page 132.
(10f)

Cast Steel in the Aged Condition. A. Pomp. *Canadian Foundryman*, Vol. 22, Oct. 1931, page 18.

An extended abstract of the article which appeared in *Stahl und Eisen*, Apr. 3, 1930, page 440. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 800.
OWE (10f)

Age Hardening of Copper-Titanium Alloys. Earle E. Schumacher & W. C. Ellis (Bell Laboratories, N. Y.). *Metals & Alloys*, Vol. 2, Sept. 1931, page 111.

The authors report the age hardening properties of Cu alloys containing up to 2% Ti.
WLC (10f)

The Improvement of a High Alloy Austenitic Chromium-Nickel Steel by Precipitation Hardening. (Die Vergütung eines hochlegierten austenitischen Chrom-Nickel- Stahls durch Ausscheidungshärtung.) E. Greulich. *Archiv für Eisenhüttenwesen*, Vol. 5, Dec. 1931, pages 323-330.

Report from the Research Laboratory of the Isolation A.-G., Mannheim. 9 references. After briefly reviewing the literature on precipitation hardening in various alloys, the author presents the results of his own investigations which were carried out on 6 Cr-Ni steels of the following ranges of composition: C: 0.22-0.51%; Si: 0.06-0.12%; Mn: 1.40-2.30%; P: 0.018-0.037%; S: 0.014-0.032%; Cr: 9.60-11.48%; Ni: 33.53-36.05%. The mechanical properties were determined after various treatments which caused precipitation of carbides. For hardness tests, cubic specimens 20 mm.^{2} of the above steels were annealed at 1200° C. for 6 hrs., water quenched and aged at temperatures from 400° to 1000° C. for from ½ hr. to 100 hrs. The hardness is essentially increased at aging temperatures between 650° to 800° C., with the largest increase shown at temperatures between 650° to 700° C. amounting to about 90% of the original hardness. To attain maximum hardness aging times between 24 hrs. and 100 hrs. are necessary at 650° C, but at 700° C. the maximum values are obtained at 24 hrs. The increase of hardness is accelerated at higher temperatures but the possible increase of hardness decreases, so that it amounts to only 65% at 750° C. and to 50% at 800° C. The other mechanical properties also were determined on test bars, annealed at 1000° C., 1050° C., 1100° C., 1150° C. and 1200° C. and aged at 700°, 750° and 800 C. for various times. In quenching from 1200° C. and aging at 700° C., the yield point is increased by about 90% to 52.3 kg./mm.^{2}; the tensile strength by about 20% to 80 kg./mm. These maximum values were attained after an 8 hr. aging. Elongation and notch toughness are correspondingly decreased, maximum, about 50%. Whereas after an 8 hr. aging, elongation and reduction of area amount to 19% and 47% respectively, the corresponding values after 100 hrs. aging are 13% and 36%, respectively. The cooling velocity must be rather rapid for air cooled specimens show but slight effects of improvement and furnace cooled specimens, none at all. The C content of the steel is of great importance. The effect of improvement is remarkable even at 0.2% C., reaches its maximum at 0.3%, but decreases again at 0.4%. The properties of improved specimens were also studied at elevated temperatures. The result is that up to 500° C., yield point and tensile strength are essentially higher than in non-improved state. The author, therefore, draws the conclusion that the creep limit will also be found at higher temperatures and that the velocity of creep is lowered. The solubility in concentrated HCl is increased by improving by about 400%. This increased solubility does not become apparent unless the specimens are aged for a very long time. The carbide precipitations are clearly shown in the aged specimens, and it could be proved that the number of the carbides precipitated has to surpass a certain limit to bring about an essential improvement of the mechanical properties. It is, furthermore, shown that the arrangement of the carbides upon planes of slippage is of importance. In comparing the results on the number of carbide particles precipitated with those of the previous investigation by E. Greulich & G. Bedeschl. (*Archiv für Eisenhüttenwesen*, Vol. 3, 1929, pages 359-363), it is found that the decrease of the number of the precipitated carbide particles with increasing drawing temperature is slower when cold work does not precede the drawing. From this fact Greulich concludes that the improvement itself is also accelerated by preceding cold work.
GN (10f)

Hardening Phenomena of the Iron-Boron-Alloys with Particular Reference to Precipitation Hardening. (Ueber Härtungserscheinungen der Eisen-Bor-Legierungen mit besonderer Berücksichtigung der Ausscheidungshärtung.) R. Wasmuht. *Archiv für Eisenhüttenwesen*, Vol. 5, Nov. 1931, pages 261-266; *Krupp'sche Monatshefte*, Vol. 12, Nov. 1931, page 273.

The system Fe-B belongs to a group of systems having a narrowed γ-field. The solubility of B in γ-iron varies between 0.10 and 0.15% B according to temperature. The A_3 point is raised by B with simultaneous lowering of A_4. A series of tests is described which showed an increase in Brinell hardness from 140 to 330 when the content of B increased from 0 to 2.5%. By addition of Mn and heat treatment higher values could be obtained; all Mn-B steels showed after a subsequent annealing a pronounced segregation hardening. Cr-Ni-B steels with not more than 0.4% B show an increase of tensile strength and elastic limit. Fe-B alloys show, according to the degree of alloying, both quenching hardness and tempering hardness. For details of the tests the paper must be referred to.
GN+Ha (10f)

Age-hardening of Alloys, Especially on the Basis of Investigations of Light Metals and of Beryllium Alloys (Vergütung von Legierungen, insbesondere auf Grund der Untersuchungen an Leichtmetallen und an Legierungen des Berylliums). G. Masing. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.-Sept. 1931, pages 414-428.

The refining phenomena of alloys occur only if the alloy can be obtained by quenching from high temperatures in the state of homogeneous crystals which disintegrate at low temperatures. These conditions are thoroughly investigated, using as a basis the diagrams of state of binary and ternary alloys and the change of technological properties in refining. Dependence on temperature conditions is discussed. Examination with X-rays produced the most fruitful results in the determination of the changes of structure in refining.
Ha (10f)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

Galvanized Steel Tank Fabricated with Bronze Welding. *Steel*, Vol. 89, Nov. 2, 1931, page 42.

Galvanized tank parts are welded together with a high-strength bronze welding rod, the metal flowing freely with absence of any boiling and fuming of the weld metal; the weld is sound and free from blowholes. Ha (11c)

Aluminum Welding Technique. *Sheet Metal Worker*, Vol. 22, Nov. 27, 1931, page 672.

The fundamental rules to be observed in aluminum welding are explained. Ha (11c)

The Welding of Monel Metal. *Sheet Metal Industries*, Vol. 5, Dec. 1931, pages 579-583.

French welding practice forms the basis for this section of the article. Positions and the preparation of welds are detailed and the nature of the blowpipe and flame, the welding wire, and the flux are given. Irregularities in the welding of Monel such as corner welds are defended and explained. AWM (11c)

Barrier to Sound Welding Removed by Research. Graphic Formula for Determining Specifications for Good Welding Steels Proves of Great Advantage to Welding Users. *Welding Journal*, Vol. 28, May 1931, pages 146-147.

A discussion of the Lincoln-Stine equilibrium curve dwelling on the manner of development and the method of use. Knowing the carbon content of a steel, the Mn, Si, and Al contents which will result in good welding properties are directly read from the graph. See also *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 16. AWM (11c)

Ocean Outfall Gas Welded. *Welding*, Vol. 2, Nov. 1931, pages 729-730.

Wrought iron pipe, 8 in. diameter, 20 ft. lengths, was oxyacetylene welded into 5 strings of 600 ft. and tied together with bell-hole welds as it was towed out to sea to serve as a sewage disposal pipe line. TEJ (11c)

Non-Destructive Testing of Welds. *Welding Journal*, Vol. 28, Nov. 1931, pages 347-348.

Reprinted from *Oxy-Acetylene Tips*. The tests described are: hydrostatic pressure, air pressure, reheating of welds and X-ray. TEJ (11c)

Bronze-Welded Casings Overcome Well Problems. *Water Works Engineering*, Vol. 84, Dec. 30, 1931, page 1784.

Description of bronze welding of cast iron pipe. The bronze welded joint insures full thickness of the pipe wall and resists ordinary attack of water. CBJ (11c)

A Few Practical Communications from the Field of Acetylen-Welding. (Einige praktische Mitteilungen aus dem Azetylenschweiss Gebiete.) H. Schuhmacher. *Autogene Metallbearbeitung*, Vol. 24, Dec. 15, 1931, pages 367-372.

Methods of welding pipe lines for steam, gas and water in domestic and industrial installations are discussed and illustrated. Ha (11c)

Improvements in Automatic Electric Arc Welding. *Welder*, Vol. 3, Sept. 1931, pages 21-24.

The advantages of automatic arc-welding are given as follows: increased speed due to the use of higher current values than can be employed by hand welding and, consequently, better penetration and a smaller number of passes for welding any given thickness of material; neater appearance and sounder weld due to elimination of the human element. In England, 95% of the welding is carried on with flux-covered electrodes. 2 processes (Metro-Vick and the Murex Welding Process, Ltd.) are described in detail and the difficulties in the way of employing flux-covered electrodes are indicated. Ha (11c)

A Severe Test for "Cresta" Electrodes. *Welder*, Vol. 3, Sept. 1931, pages 31-32.

2 semicircular mild steel plates of 5/16 in. were welded together to form a disk of 9 in. diameter and then, after heating to flanging heat, a cup-shaped vessel was formed by driving through a ball 4 in. in diameter under a steam hammer. After this, it was reheated and swaged down to a diameter of 3 in. under a steam hammer. After reheating again, it was flanged to a diameter of 5 in. The weld remained intact during the whole process. Ha (11c)

Steel Founders Hear Talk on Welding of Rolled and Cast Steel Parts. *Steel Founder*, Vol. 2, Jan.-Feb. 1932, pages 3-5.

In a discussion the American Society for Testing Materials and American Railways Association specifications are endorsed by the Steel Founders' Society of America. Ha (11c)

Arc and Resistance Welding of Monel Metal. (Ueber das autogene und elektrische Schweissen von Monel-Metall.) F. Schüppel & W. Kästner. *Zeitschrift für Metallkunde*, Vol. 23, Oct. 1931, pages 286-291.

Physical test data (breaking strength, tensile strength, reduction in area, and elongation) are given on sections of Monel metal welded by the arc and resistance methods. These show that Monel may be satisfactorily welded without the use of flux powders or pastes by electric resistance welding and arc welding. Electric butt seam welding is not successful. The finished welds resist corrosive attack successfully of bleaching solutions, soap baths, hot water, caustic soda solutions, dyes such as sulphur black and colored and vat dyes,—to a limited extent in hypochlorite lye and formic acid, and poorly in solutions of copper mordants. RFM (11c)

Acceptance of Watergas Lap-welded Boiler Drums and Shell Rings. (Abnahme wassergas-überlapptgeschweisster Kesseltrommeln und Schüsse.) E. Rüter. *Die Wärme*, Vol. 54, Apr. 25, 1931, pages 312-316.

The paper before the Zentralverband der Preussischen Dampfkessel Überwachungsvereine, 1931, takes the following steps: manufacture of water gas lap-welded shell rings and drums, question of weldability, acceptance in accordance with the regulations of the Verein der Grosskesselbesitzer, supplementary testing methods such as tensile and bend tests, serve as inspection of the semi-finished gas-welded seams. EF (11c)

New Code for Fusion Welding likely to be Misapplied. F. G. Sherbondy. *Steel*, Vol. 89, Nov. 30, 1931, pages 35-36.

Some of the specifications in the new code give rise to misinterpretation; the difficulties of classification are discussed and the coöperation of all companies urged to take into account the new developments in this comparatively new field. Ha (11c)

The Arcatom-Welding Process; Electric Arc-Protective Gas-Welding in Dissociated Hydrogen Gas According to Langmuir. (Das Arcatom-Schweissverfahren; Lichtbogen-Schutzgasschweissung in dissoziiertem Wasserstoffgas nach Langmuir.) S. Sandelowsky. *Zeitschrift Verein Deutscher Ingenieure*, Vol. 75, Oct. 31, 1931, pages 1361-1364.

After a thorough discussion of the principles of the process, the metallurgical conditions of the weld and its tests and the fields of application, the advantages of this method are summarized; the structure is finely crystalline, the strength of welds is hardly inferior to that of non-welded sheets. The economy is good for thin sheets, 1 to 6 mm. Most steels and non-ferrous metals can be welded by this process. Ha (11c)

The Permissible Loading of Arc-Welded Seams. (Die zulässige Beanspruchung von lichtbogengeschweissten Nähten.) S. Sandelowsky. *Maschinenbau*, Vol. 10, Mar. 19, 1931, pages 197-199.

The article discusses the importance of calculating the strength of the weld in machines, the relative costs of 1 kg. of welding rod, the lowest stress values for seams, permissible stresses, numerical values and the influence of stresses. MAB (11c)

The Oxy-Acetylene Welding of Copper and Aluminum and Some of their Alloys. Francis A. Westbrook. *Metal Industry*, New York, Vol. 29, Oct. 1931, pages 424-425; Nov. 1931, pages 469-470.

The welding of brasses, bronzes and Monel metal is discussed. Cu completely deoxidized with Si can be readily welded. Welding rod of commercially pure Al and a good Al flux are requisites for welding Al. For strong Al alloys, simple joints must be made using welding rods of 5% Si or of same composition as the base metal, in which case allowance for contraction must be made. After welding it is advisable to heat treat at 890-940° F. and water quench. PRK (11c)

The Rigidness of Rails when their Joints are welded (Die Steifheit der Eisenbahngleise mit geschweissten Schienenstoessen). W. Wildt. *Zeitschrift des Oesterreichischen Ingenieur- und Architekten Vereins*, Vol. 83, Apr. 30, 1931, pages 89-93.

The advantages gained by the welding of rails are pointed out and the precautions which must be borne in mind on welding rails are given. The warping due to temperature influences are calculated for different mounting profiles of the tracks. 6 illustrations. EF (11c)

Welding of Nickel (Das Schweissen von Nickel). H. Obermüller. *Apparatebau*, Vol. 44, Jan. 22, 1932, pages 12-13.

Outline of the welding practice of nickel. GN (11c)

Inspection Service for Welded Structures Seen as Need. H. L. Whittemore (Bur. of Standards). *Steel*, Vol. 88, Feb. 1931, page 44.

Points out the urgent need in the welding industry for an authoritative consulting service to qualify welders, pass on welding methods, criticize the suitability of structural design, inspect, test and approve of work under way, and certify to the reliability of the completed job. JN (11c)

The Efficiency of Welded Joints. More recent View-points regarding their Valuation and Calculation for the Construction of Boilers and Tanks. (Der Wirkungsgrad von Schweissverbindungen. Neuere Gesichtspunkte für ihre Bewertung und Berechnung im Kessel- und- Behälterbau.) K. Vigener & F. W. Rüdel. *Die Wärme*, Vol. 54, Nov. 28, 1931, pages 875-888; Dec. 5, 1931, pages 901-908.

The article subdivides the topic as follows: Calculation of the wall thickness of cylindrical boiler drums. The notion "seam efficiency" and its significance specified by the authoritative regulations. "Method efficiency" (changes in physicals, later occurrence of internal stresses) and "shape efficiency" (depending on the kind or shape of the joining) a) welded joints, b) riveted joints. New proposal on the method efficiency for welded joints and determination of the "partial efficiency." Shape efficiency of welded joints and their determination by a) theoretical derivations b) tensile tests. Tables collecting data on shape efficiencies for longitudinal and circumferential seams. Influence exerted by the location of the seam. Summary: limiting conditions for the efficiency degrees. EF (11c)

Testing of Alumino-Thermally Welded Rail Joints in Soviet Russia. (Prüfung von aluminothermischen Schweissungen bei Schienenstössen in U.d.S.S.R.) B. Tchistjakow. *Organ für die Fortschritte des Eisenbahnwesens*, Vol. 86, Aug. 15, 1931, pages 352-354.

62 welded rail joints were submitted to static and dynamic testing respectively. The experiments under the auspices of the Russian Government refer to (a) a "combined welding method" and (b) to butt welding. Tests concerning the bending and ultimate load determination yielded the following data:

	bending	ultimate load
(a)	37 500 kg.	64 kg/mm²
(b)	33 200 kg.	57 kg/mm²

The experience gained on the application of the combined welding method and on butt welding are detailed. EF (11c)

A Personal History of the Arc-Welding Process. J. C. Lincoln. *Boiler Maker*, Vol. 31, Oct. 1931, pages 265-267.

An historical sketch of the development of arc welding, up to its latest improvements, as illustrated by the Lincoln Electric Company. Ha (11c)

Impressions in the Field of Welding Technique in the United States of America (Eindrücke auf dem Gebiete der Schweisstechnik aus den Vereinigten Staaten von Amerika). H. Lottmann. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Oct. 10, 1931, pages 1265-1269.

The latest developments, particularly in electric arc welding, both manual and automatic, are described and the details of welds for tanks, boilers and in shipbuilding are discussed. Ha (11c)

The Valuation of Welding with Reference to the Legal Enactments on the Manufacture of Boilers. (Bewertung des Schweissens in den für die Herstellung von Dampfkesseln gegebenen gesetzlichen Bestimmungen.) K. VIGENER. *Die Wärme*, Vol. 54, June 27, 1931, pages 481-492.
Historical review of the government's enactments. Specifications for welding and riveting. Comparative valuation of both methods of joining. Practical examples of actual welding performances. Testing methods for welded seams. Résumé of the advances of welding technique. Regulations in foreign countries and future trend. A paper before the combined meeting of 3 German engineering associations. EF (11c)

Electric Arc Welding in Mines. CARL LEE. *Electrical World*, Vol. 98, Nov. 28, 1931, pages 953-954.
Electric arc welding is effecting substantial savings in the salvage of worn or broken parts in a majority of operating mines. A motor-generator set is cheapest for more than 85 hrs.' welding time/yr. Tires are also built up of weld metal. WHB (11c)

Production Welding of Auto-Body Stampings. J. W. MEADOWCROFT & JAMES J. PAUGH. *Metal Stampings*, Vol. 4, Dec. 1931, pages 953-956.
Modern stamping designs and fabrication methods of welding parts of the automobile body are discussed. Ha (11c)

Fire-welded Seams on Headers. (Feuergeschweisste Nähte an Wasserkammern.) H. TÜRKE. *Die Wärme*, Vol. 54, Nov. 28, 1931, pages 890-892.
The paper reports on the difficulties which were encountered with the defective welded joints on the flanged end plates of the front headers of two 300 $m.^2$ boilers. The headers are electric-welded and strengthened by Höhn lashes and the remaining fire-welded seams are strengthened by welded-on bracings. The single steps of the reconstruction work are described. EF (11c)

The Structural Steel Welding Committee's Report. FRANK P. MCKIBBEN. *Welding*, Vol. 2, Dec. 1931, pages 808-810.
The author refers to this report as a classic of greatest value to engineering and summarizes it as follows: (1) Permissible unit stresses, namely 11,300 $lb./in.^2$ shear, 13,000 tension, 15,000 compression, specified by the American Welding Society for structures bearing quiescent loads, are approved. (2) Qualified welders of commercial joints may be expected to produce strengths within 12% of a general average for a given type of joint. (3) The types of joints investigated are divided into 2 classes, depending upon the degree of symmetry or eccentricity in the welds. TEJ (11c)

Welding of Acid Resistant Steels. (Das Schweissen von säurefestem Stahl.) E. R. THEWS. *Die Metallbörse*, Vol. 21, Jan. 24, 1931, pages 149-150.
The difficulties encountered in the welding of stainless steels are pointed out and the successful welding performance is fully discussed with reference to (a) the arc welding process and (b) oxy-acetylene welding. EF (11c)

The Practical Application of the Arcogen Welding Method with Special Reference to its Suitability to Welding of the Technically Important Materials. (Die praktische Anwendung des Arcogen-Schweissverfahrens unter besonderer Brücksichtigung seiner Geeignetheit für das Schweissen der technische wichtigen Werkstoffe.) H. MUENTER. *Die Schmelzschweissung*, Vol. 10, Dec. 1932, pages 279-284.
The principle of the arcogen method is briefly explained. The method of its application for and the results on steels of low carbon up to 50 mm. thickness is described, obtained values of tensile strength, elongation and notch-toughness are given, also metallographic results of cold-bending tests. Ha (11c)

Welding of Stainless and Corrosion Resistant Alloys. W. B. MILLER (Union Carbide & Carbon Lab.) *Metal Progress*, Vol. 20, Dec. 1931, pages 68-72.
General technique of welding these alloys is described. Neutral flame, flux which will dissolve oxides of Fe and Cr and show suitable fluidity, desirability of preheating, care of the cooling weld to avoid straining in its tender temperature range and cleanliness are emphasized. Special precautions with individual alloys are discussed under 6 headings, cutlery stainless, low carbon stainless, high chrome iron, 18-8 type, high Cr-Ni-Si alloys and heat resistant alloys. WLC (11c)

Failures during the Welding of Overhead Cranes (Nahtrisse während der Kranschweissung). K. MELCHER. *Zeitschrift des Oesterreichischen Ingenieur- und Architekten Vereins*, Vol. 83, Sept. 18, 1931, pages 291-292.
The writer reports at length how to overcome the shrinkage difficulties experienced during the welding of a 10 ton over-head crane. EF (11c)

Erection of Yale Welded Buildings. D. E. KING. *Welding*, Vol. 2, Nov. 1931, pages 745-750.
Paper presented before the October meeting of the Pittsburgh Section of the American Welding Society. Details of construction of the Yale University group of welded buildings. Includes estimating, detailing and fabrication, erection, the field force, inspection, general information, suggestions, comparison of welds and rivets and advantages credited to welding. TEJ (11c)

Opportunities for Welding-Trained Men in Metal Working Trades. S. LEWIS LAND. *Heating & Ventilating*, Vol. 29, Jan. 1932, pages 43-45.
Welding insures lower first costs and maintenance costs. Data obtained from a welded pipe installation in one of the buildings of the Bureau of Standards in Washington shows a considerable saving in weight and bulk, in some cases as much as 100%. WAT (11c)

Determining Factors for the Application of Oxy-Acetylene Welding in Welding-On of Flanges (Massgebende Gesichtspunkte für die Anwendung der Azetylenschweissung beim Aufschweissen von Flanschen). HANS KRUSE. *Autogene Metallbearbeitung*, Vol. 24, Oct. 15, 1931, pages 307-310.
For medium and high-pressure pipe lines, oxy-acetylene welding has given excellent results in the welding of flanges and branches. A few examples are illustrated. Ha (11c)

Welding of Steel Girders. (Schweissen von Blechträgern.) HANS KRUSE. *Autogene Metallbearbeitung*, Vol. 25, Jan. 15, 1932, pages 25-30.
The author gives examples for welded girders made up of T-steels and flat plates and points out the advantages of this method over riveting; prerequisite for successful construction is careful design which must take into account the particularities of welding. The calculation of an example is carried out in detail, and tests made to verify the design are described. Ha (11c)

Boiler Repair Welding. (Dampfkessel-Reparatur-Schweissungen.) J. KREFFT. *Die Wärme*, Vol. 54, Apr. 4, 1931, pages 259-260.
The author summarizes his paper read before the Verband für autogene Metallbearbeitung, Braunschweig, 1931, which discusses some examples of boiler repair work performed by welding. EF (11c)

Typical Example of a Difficult Cast-Iron Welding. (Schulbeispiel einer schwierigen Gusseisen-Warmschweissung.) KOHRS. *Die Schmelzschweissung*, Vol. 11, Jan. 1932, page 4.
The broken driving block of a 20 m. turn-table was successfully repaired by welding; the parts were first heated slowly to 450° C. and annealed after welding. Ha (11c)

Distribution of Tension in Welded Joints with Special Regard to Boilers. (Spannungsverteilung in Schweissverbindungen unter besonderer Berücksichtigung des Kesselbaues.) KOCHENDOERFER. *Autogene Metallbearbeitung*, Vol. 25, Jan. 1, 1932, pages 5-12.
The distribution of tension in butt-welds was determined by means of the laminar flow pictures of Hele-Shaw. A quantitative evaluation of the pictures is, however, not possible, it shows merely the danger spots of a joint. The actual course of the tensions can be determined by elastic-optic methods, from which then the most favorable profile of a butt-weld can be theoretically developed. The procedure is described and photographs of flow pictures reproduced. Ha (11c)

Scarfing Process is Effective in Eliminating Defects. J. D. KNOX. *Steel*, Vol. 88, March 19, 1931, pages 36-38.
A method of removing seams, scales, scratches, etc., from the surface of billets, slabs or other semi-finished shapes before the stock runs through the finishing mills, by means of scarfing torches similar to ordinary cutting torches is described. Ha (11c)

Lead Welding. OWEN C. JONES (Linde Air Products Co.). *Journal American Welding Society*, Vol. 10, Nov. 1931, pages 41-42.
The author outlines the general procedure for oxy-acetylene welding of Pb and describes a particular application of this process in the manufacture of lead lined steel storage tanks for H_2SO_4. TEJ (11c)

Repair of a Pressure Tank Lined with Aluminum. (Reparatur eines mit Aluminium ausgekleideten Druckgefässes.) W. JOHAG. *Autogene Metallbearbeitung*, Vol. 24, Dec. 1, 1931, pages 355-356.
Description of procedure. Ha (11c)

How Fast Does the Student Welder Learn? JAMES R. GRIFFITH (Oregon State College). *Welding*, Vol. 2, Dec. 1931, pages 804-807.
An experiment with learning curves of student gas welders in which the author attempts to establish an index by which one could anticipate an individual's ability to learn welding. TEJ (11c)

Electric Welding—Present and Future. C. A. HADLEY. *Welding Journal*, Vol. 28, Nov. 1931, pages 341-343; Dec. 1931, pages 374-375.
First installment of a paper read before the members of the Birmingham Electric Club, Nov. 20, 1931. A general review of arc and resistance welding applications. Several resistance welding machines are described. TEJ (11c)

Welding of Pressure Vessels is Winning Approval. J. C. HODGE (Babcock & Wilcox Co.). *Steel*, Vol. 88, Jan. 15, 1931, pages 44, 46.
During the past year, the Boiler Code Committee of the American Society of Mechanical Engineers has proposed tentative codes for the testing of fusion welded steam boiler drums and unfired pressure vessels. These tests include examination of representative test specimens, X-ray examination of the weld and hydrostatic testing. The U. S. Navy has accepted the use of welded construction in the fabrication of drums for 24 boilers now being built. Tests on 2 welded steel shells are described and the use of the X-ray equipment is illustrated. JN (11c)

An Alternating-Current Arc Welder. J. B. GIBB. *Electric Journal*, Vol. 28, Dec. 1931, pages 665-667.
The new type welder with a high-frequency oscillator removes the danger in a.c. welding of dangerously high overcircuit voltage, an unstable arc and the difficulty of using small currents. The new outfit consists of a welding transformer with means for adjusting the current by small steps and an oscillator which makes the arc as easy to handle as a d.c. arc. Characteristics are: lightness, cheapness, convenience, safety, ease of operation and adaptability. WHB (11c)

Electric Welding Saves 30 Per Cent of Job Cost. C. L. IPSEN. *Electrical World*, Vol. 98, Nov. 28, 1931, page 966.
A test, on a considerable scale, of electric welding and casting showed a saving of 30% of the cost of the cast job. WHB (11c)

The Strength of Frontal and Lateral Welds. E. HOEHN. *Engineering*, Vol. 132, July 24, 1931, pages 115-118.
Translated from a report to the Swiss Boiler Owners' Association. LFM (11c)

The Shielded Arc Process. C. J. HOLSLAG. *Industry & Welding*, Vol. 3, Jan. 1932, pages 21-24.
The process consists of covering the electrode so as to shield the arc and provide a refining atmosphere and in addition to the speed and refined metal advantages gained by this process, layer annealing is used. The procedure for welding V-cuts and the electrodes, voltage and current required for different thicknesses of the weld are tabulated. Ha (11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

The Stevens Open Hearth Furnace. THOMAS G. KUS. *Proceedings Engineers' Society of Western Pennsylvania*, Vol. 47, Oct. 1931, pages 391-404.

The Stevens open hearth furnace was primarily designed to establish and maintain, within the furnace, conditions that will promote more uniform metallurgical reactions; conditions that will reduce loss of metal and thereby result in greater yield; and conditions that will reduce inclusions, and produce better metal. The purpose was also to attain the highest thermal efficiency by better combustion and maximum heat recovery and to speed up and, thereby, increase the tonnage output of a given size unit. The Stevens furnace, both basic and acid, has been in continuous service long enough to establish the principal facts of these outstanding advantages. Patents have been granted Arthur L. Stevens for his methods of construction and operation, and demonstrations in the past 4 years have prompted others to imitate the method in part. In the discussion a fuel consumption of 3,500,000 B.t.u./ton of product was quoted as a monthly figure for one unit. WAT (12a)

The Production of Synthetic Cast Iron in the Electric Furnace (Die Erzeugung von synthetischem Gusseisen im elektrischen Ofen). R. B. DUPUIS. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, page 867.

A brief review of the historical development of the production of cast iron from steel scrap and C. This manner of manufacture has gained a great importance in many countries, especially in Italy. Ha (12a)

The Manganese Reduction During the Steel Melting Process (Zur Frage der Manganreduktion bei der Stahlherstellung). ED. MAURER & W. BISCHOF (Bergakademie Freiberg). *Zeitschrift für physikaische Chemie*, Abt. A, Vol. 157, Nov. 1931, pages 285-309.

Based on their previous equilibria investigations the authors consider quantitatively the factors dominating the distribution of manganese between the steel and the slag in the basic open-hearth process. The influence of the input of Mn, the amount of slag, the slag analysis and the temperature are successively taken up. Formulae covering the Mn-balance are derived. The theoretical deductions made are in very satisfactory agreement with data collected in the plant. The results are presented in 14 diagrams. 7 references. 3 tables. EF (12a)

Physicochemistry of the Reactions Between Steel Bath and Slag (Physikalisch-chemische Unterlagen zur Beurteilung der Beziehungen zwischen Stahlbad und Schlacke). G. TAMMANN. *Archiv für Eisenhüttenwesen*, Vol. 5, Aug. 1931, pages 71-74.

Report 212 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The author shows that the classification of the electro-chemical potentials as it holds with regard to aqueous solution of metals also holds in general with regard to liquid melts of the chlorides and silicates of metals. Those metals which are nobler than iron migrate from the slag to the steel bath when they are not yet contained in the steel bath, and metals which are less noble than iron migrate from the steel bath into the slag. According to this rule, the metals of the alkalies, the alkaline earths migrate from the steel bath into the slag or they remain in the slag if they are already present in the slag. The above rules as to the direction of the reaction, however, can only be applied when the metal in consideration in the silicate melts is present as cation. The paper then deals with the equilibria between the binary mixtures of metals and liquid mixtures of its salts and shows that there exist simple rules about the quantitative distribution of alloying elements between steel bath and slag within the concentration range which is governed by the laws holding for diluted solutions. GN (12a)

The Distribution of the Alloying Elements of Iron between Steel Bath and Slag During Steel Production (Die Verteilung der Eisenbegleiter zwischen Stahlbad und Schlacke bei der Stahlerzeugung). G. TAMMANN & W. OELSEN. *Archiv für Eisenhüttenwesen*, Vol. 5, Aug. 1931, pages 75-80.

Report 213 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The paper endeavors to deduce some simple empirical rules about the distribution of the admixtures of the steel between steel bath and slag. This has been done by critically reviewing the literature on the subject. The results are as follows: The distribution of Mn between steel bath and slag is governed by the simple law of mass action. With basic slags having the ratio of CaO to SiO_2 above 2, the equilibrium constant is independent of this quotient, but the equilibrium constant is decidedly affected by this quotient when the ratio of CaO to SiO_2 is below 2. According to the present known data, the equilibrium constant is not very much affected by the temperature. With basic melts, the distribution of Mn between bath and slag is in equilibrium only in the case the P reaction is also approximately in equilibrium. GN (12a)

Lime-Iron Oxide-Silica Slags (Über Kalk-Eisen-Silikatschlacken). E. J. KOHLMEYER & G. SITZ. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie*, 6th session, Liege, June 1930, pages 429-435. 7 figures, 11 references.

The dissociation of Fe_2O_3 in these slags was studied by magnetic methods. The melting points of the slags are shown in ternary diagrams. HWG (12a)

Fundamental and Applied Research on the Physical Chemistry of Steel Making. C. H. HERTY, JR. *Blast Furnace & Steel Plant*, Vol. 19, Feb. 1931, pages 277-278.

Reproduction in part of *Report* No. 3054 of the *U. S. Bureau of Mines* on investigations of clean and dirty steels from various heats. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 42. Ha (12a)

Soda Ash as Desulphurizing Agent in the Foundry. *American Metal Market*, Vol. 38, Sept. 16, 1931, page 10.

Reprinted from Manchester Guardian. Desulphurizing by means of soda ash is both simple and inexpensive. Process can be applied at various stages in the manufacture of steel and iron and alloys with the regular routine followed. Reagents required are commercial powdered soda ash and ground limestone. Reduction of S content of the metal prevents cracking of steel castings and is also accompanied by definite improvement in the physical properties, together with almost complete elimination of non-metallic inclusions of sulphides, oxides, etc. Cost of manufacture is reduced because products can be made from pig iron and coke of higher S content and greater proportion of scrap metal. DTR (12a)

The Comparison of Different Fluxes for Magnesium Alloys. K. Endo. *Kinzoku no Kenkyu*, Japan, Jan. 1932, pages 24-30.

Mg and its alloys were melted with various fluxes and the effect of the latter was compared by measuring the electrical resistance, tensile strength and microscopic structure of metals obtained. The melting loss was also compared. The best result was obtained by using 3% of a flux consisting of 66 % $MgCl_2$ + 7 % MgF_2 + 23 % KCl + 4 % NaCl. The electric resistance of pure Mg was 3.983×10^{-6} ohm and the tensile strength 13.88 kg./mm². The tensile strength of electron A.Z.D. and Dow metal D was 19.8 and 19.6 kg./mm² respectively which is 1 to 3 kg. greater than the alloys treated with other fluxes. KT (12a)

The Bessemer Process and Its Product. R. S. McCaffery. *Yearbook American Iron & Steel Institute*, 1931, pages 351-386.

Includes discussion. The author surveys the present position of the Bessemer process in America. The change of conditions taking place for some years past has placed the process in a more favorable position than it occupied a few years ago. Bessemer steel has retained its place for those uses where it has always been superior and has replaced other steels in some of the newer applications. This improved position is due to larger Bessemer ore reserves than formerly, a more complete knowledge of metallurgical chemistry, the introduction of control methods and new equipment. Electrically-driven blowing equipment has been installed recently at one plant, each converter being provided with an individual motor-driven centrifugal blowing unit on an individual air line to the converter. Any blower can be connected with any converter with complete control from the blowing pulpit. The operator has a pressure gage, a volume meter, and a tachometer in addition to start, stop, and speed regulation buttons. Two charts are given of 2 soft steel blows, one blow maintaining constant pressure, after cold metal additions, and the other maintaining constant volume for the same time. Where constant pressure was maintained, the volume remained practically constant in the early part of the blow, but in the latter part the volume increased rapidly from 18,000 to 30,000 ft³/min., although the pressure remained the same. The volume at the end increased about 60%. The slope of the volume curve decreases and flattens out just before the turn down. In the case where the volume was kept constant, corresponding pressure decreases are shown. This variation of metal bath resistance to the blast is caused by changes in the viscosity of the bath because of changes of composition and temperature and also by the increase of weight of the bath due to the elimination of C toward the end of the blow. A chemical change in the molten metal bath can be noted almost instantaneously by means of the pressure gage, and a change in the rate at which oxygen is added can be made in a few seconds. The author draws attention to the fact that high air pressure does not mean high tonnage production and that a reduction in pressure may cause a very considerable decrease in blowing time and a decrease in blowing energy. A table is given showing the results obtained by increasing the number of tuyeres and decreasing the blast pressure. It is predicted that in the future the Bessemer converter will be operated on a predetermined cycle, with adjusted composition and initial temperature. The volume and pressure of the air blast will be maintained or varied as the blowing cycle chart indicates, the regulation being done by automatic control. The turn down will be done automatically either when the required air volume has been blown into the converter or by the carbon-flame drop, or one method may be used to check the other. The blown metal on the turn down will then be at the proper temperature, and it will contain the desired amount of Si and Mn to secure the proper softening reaction which will be completed during pouring. For other than soft steel blows, the turn down will be made automatically when the predetermined volume of air has been blown to obtain the specified C. The bath will contain the requisite Si and Mn which, being residual, will rapidly deoxidize the metal so that, on pouring, no additions need be made for this purpose. Ha (12a)

Reverberatory Melting of Tin and White Metal Scrap. (Flammofenschmelzen von Zinn-und Weissmetallrückständen.) E. T. Richards. *Die Metallbörse*, Vol. 21, Apr. 4, 1931, pages 627-628; Apr. 18, 1931, pages 726-727.

A critical discussion on the melting of tin and white metal scrap in blast furnaces and in reverberatory furnaces respectively is anticipated in the introduction and the practice and experiences with respect to the melting in the reverberatory furnace are fully discussed, whereby much regard is paid to the calculation of the furnace charge. EF (12a)

Fluxes for Melting and Remelting of Aluminum. (Flussmittel beim Schmelzen und Umschmelzen von Aluminium.) E. R. Thews. *Die Metallbörse*, Vol. 21, Jan. 24, 1931, pages 147-148; Jan. 31, 1931, pages 195-196.

The affinity of Al for oxygen and nitrogen, the low specific gravity of Al and its contaminations and the embedding tendency of aluminum oxide are considered and conclusions are drawn, aside from economical considerations, in regard to the peculiar metallurgical demands which must be fulfilled by fluxes indispensable for the melting of Al and Al-scrap. The different mixtures of fluxes and their properties are dealt with. EF (12a)

Silico-Spiegel Deoxidizing Agent Makes Uniformly Clean Steel. *Steel*, Vol. 88, Mar. 19, 1931, page 46.

Silico-spiegel is an alloy containing 7-8% Si and 25-30% Mn; its low melting point at about 1250° F. insures rapid deoxidation, and its composition leads to the formation of extremely large inclusions which rise rapidly at about 600 to 2400 in./min., thus providing a uniformly clean steel. Ha (12a)

Open-Hearth Operators Study Quality of Rimming Steel. *Steel*, Vol. 89, Dec. 14, 1931, page 38.

The best methods of obtaining high-grade steel from open hearth furnaces, distribution of heat and composition of metal in different levels within the bath, method of sample taking, velocity of refining action, are discussed with reference to an investigation of these questions by the Verein deutscher Eisenhüttenleute. Ha (12a)

On Dimensions and Operation of German Thomas Converters (Ueber Abmessung und Betriebsverhältnisse deutscher Thomaskonverter). *Stahl und Eisen*, Vol. 51, Sept. 3, 1931, pages 1105-1113; Sept. 10, 1931, pages 1136-1148.

This is the résumé of the results of a questionnaire sent to 17 German Thomas steel plants. General arrangement and operation are described; capacity, composition of charge, additions, amount of slag are tabulated. Figures on the consumption of refractory bricks and tar are given. All dimensions of the converters are given and compared. The last part deals with results of operation, the lining and life of converters and converter bottoms. GN (12a)

Vaporization of Magnesium in Vacuum (Verdampfung von Magnesium im Vakuum). W. Kaufmann & Ph. Siedler. *Elektrotechnische Zeitschrift*, Vol. 37, Aug.-Sept. 1931, pages 492-497; *Die Metallbörse*, Vol. 21, July 4, 1931, page 1255.

Mg evaporates very easily. The following 3 methods are possible: (1) distillation, (2) sublimation, (3) evaporation from a melt and condensation in a solid state. The range for distillation is above 650° C. and a pressure of 2 mm. Hg gage. Sublimation can be effected only at temperatures between 500° and 650° C. and pressures of 0.05-2 mm. Hg. The third method requires a definite temperature gradient between the place of evaporation and condensation and is an extreme case of distillation. The experimental arrangement is described and the precautions which are necessary to prevent foreign particles from being drawn along in the evaporation current are discussed. A purity of 99.99% Mg could be obtained. Pure Mg crystallizes easily in giant crystals in a manner similar to Cu. For a practical application, sublimation is the most promising process. EF+Ha (12a)

The Melting of Metals; Induction Furnace Design. Robert Hadfield. *Times*, London, Faraday Number, Sept. 21, 1931, page 18.

The principles of the modern coreless high frequency furnace are based on the Faraday discovery of induction. The construction and materials used are explained. The use of such furnaces covers a very wide range. Materials requiring 2000°-3000° C., for instance high class tool and magnet steels, heat-resisting and corrosion-resisting alloy steels, Ni-Cr alloys, tungsten-chromium-cobalt carbide, silica ware, precious and non-ferrous metals generally, can be melted. The melting is caused by the heat developed in the mass by the "Foucalt" eddy currents. The thermal efficiency of the energy exchange, that is the ratio of the heat utilized as sensible and latent heat in the metal to the heat equivalent of the power supplied at the bus bars, is from 50 to 60%. The cost of operation is discussed briefly as dependent on local conditions. Ha (12a)

Further Experiments on Oil-Hardening and Air-Hardening Cast Irons. J. E. Hurst. *Foundry Trade Journal*, Vol. 45, Dec. 3, 1931, pages 345-348.

The author records the results of further experiments on the heat-treatment of cast iron by air-hardening, and oil-hardening and tempering. The experimental work was conducted on the standard ring form specimens of the B.E.S.A. Air Board Specification 4K6. He finds that in suitable thin sections, plain unalloyed cast iron can be hardened by oil-quenching from suitable temperatures. Cr irons are capable of being similarly hardened, the presence of Ni being unnecessary to obtain the hardening effect. In suitable thin sections, plain Cr iron appears to give higher hardness values than Ni-Cr iron, and the hardening effect is more stable on tempering. In thicker sections, ordinary cast iron is not particularly susceptible to hardening by quenching in oil; Ni and Cr increase the hardening capacity, Ni having the effect of increasing the depth of penetration and the degree of hardness obtainable. A higher hardening temperature (920° C.) gives inferior results. The lowest possible quenching temperatures are to be desired. The development of air-hardening properties in Ni-Cr iron by the addition of Mn is discussed, and the effects of normalizing on the hardness and strength values have been shown to be of use in making the initial hardness more uniform and in slightly improving the strength properties. Quenching in molten salts at 150° C. results in a slightly higher strength value after hardening and prior to tempering and in a slightly lower hardness value. OWE (12a)

The Use of the Rotating Furnace for Melting Gray Iron (L'impiego dei forni girevoli per la rifusione della Ghisa). F. Giolitti. *La Metallurgia Italiana*, Vol. 23, Oct. 1931, pages 942-954.

The Stein-Brackelsberg and similar revolving powdered coal furnaces are favored over the cupola because of a lower pick-up of S and better control of composition. Suitable pulverized coal costs 130 lire/ton and, with a 5 ton furnace, not over 16% of the weight of the iron melted is required, while the cupola will take at least 13% of metallurgical coke costing 170 lire/ton, the fuel cost, under Italian conditions, thus being in favor of powdered coal. High test or pearlitic cast iron (steel added to the charge) is very satisfactorily made in the furnace, even when cast iron turnings are used. Tests cited show good properties. Use of the powdered coal furnace for mixing, superheating, degasifying and making additions to correct the composition of cupola metal is mentioned as a future possibility. Experiments on the use of the furnace for melting steel are encouraging. HWG (12a)

The Manufacture of Cast-Iron Molds for Steel Plants. (Die Herstellung von Stahlwerkskokillen.) R. Travaglini & R. Comina. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 6, 1931, page 867.

The composition, manufacture of molds and causes of waste are discussed. Castings from chill molds do not have a great mechanical strength but resist great fluctuations of temperature. C is present in an almost free state. The composition of such castings is 3.2-3.8% C, 1.5-3% Si, 0.7 Mn, 0.07% S. The charge is made up of 3/5 pig iron and 2/5 crushed mold-castings, not burnt. The molds are made by a centrifugal sand-molding machine; the core is made by a special device. Molds of 3 ton capacity can stand a little more than 300 castings. Waste castings are caused, generally, by cracks, corrosion and burns or erosions. A few suggestions are given for elimination of these causes. Ha (12b)

Experiences with Ingot Molds (Erfahrungen mit Stahlwerks-Blockkokillen). F. W. Morawa. *Stahl und Eisen,* Vol. 51, Oct. 1, 1931, pages 1221-1228; Oct. 8, 1931, pages 1256-1263.

Report 218 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The selection of ingot molds must be based, in the first place, on metallurgical considerations, i. e. the cross-section and weight of the ingots must be determined with due consideration of the production program of the individual steel mill. The molds must then be dimensioned and the material of the molds, either cast iron or steel molds, be so chosen that the highest degree of efficiency is guaranteed. In order to attain this end, the highest lifetime of the molds, with due regard to the continued production of sound steel ingots, is of prime importance. The experiences of the author favor the cast iron mold which, in spite of the shorter life in comparison with the steel mold, gives a sound ingot surface and which can also be handled more quickly than the steel mold. This experience does not prove that the cast iron mold is always better than the steel mold since there are also cases known where the steel mold proved to be superior. The life of cast iron molds was studied in applying various methods of cooling the molds. Some of the results are tabulated below:

Life of Molds	continually used	Molds used at every 2nd heat
Water dipped	128	...
Temporarily water dipped	160	209
Water sprayed	170	213
Air cooled	198	232

These results indicate that the best cooling would be a normal air cooling with 2 sets of molds, using them intermediately for subsequent heats. With this working procedure, lifetimes of 250 heats have been attained. The last chapter of the paper deals with the manufacturing of gray cast iron and steel molds with special American experimental molds composed of 2 materials, and with molds provided with special cooling devices. Finally the addition of alloying elements to cast iron is referred to. The prime alloying elements are: Cr, Ni and V. Ti has been used in England. GN (12b)

The Regular Reactions in the Solidification and Crystallization of Steel Ingots. (Die gesetzmässigen Vorgänge bei der Erstarrung und Kristallisation der Stahlblöcke). Bernhard Matuschka. *Archiv für das Eisenhüttenwesen,* Vol. 5, Jan. 1932, pages 335-354.

Report No. 220 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. Includes tables of entire results, 36 illustrations, 24 references, and excellent discussions. After a review of the state of our knowledge on origin, character, and crystallization of ingots, a new method of investigation of C steels is described, by which the formerly unknown ingot structure may be seen by the so-called "blue-short fracture." Systematic tests of various casting and cooling conditions on the structure of a steel with 0.7% C. led to disclosure of disintegration reactions of ingot crystallization. For the primary crystal formation and the grain disintegration, the casting temperature and stopping time, or slow cooling and super-cooling conditions, especially in the critical temperature range, are decisive factors. Character of different types of steel ingot structure is given in complete detail and important distinctions between primary and secondary structure are defined. Comparisons of behavior of different steels may be made from the regularities observed in crystal structure of C steels. The great importance of formation of steel ingot structure is discussed with regard to heat treatment purposes and building up of finished materials. GN+DTR (12b)

Aluminum Castings in Permanent Metal Molds. V. Friedberg. *Vestnik Metallopromyschlennosti,* Vol. 9, Nov. 1929, pages 116-132.

The principles on which metallic molds for castings must be constructed are laid down. The shapes of the different sections of the molds and their methods of joining are discussed in detail. For gravity castings, special modifications are required for Al in view of its low density. To avoid the formation of cavities due to contraction on cooling, the lowest practicable pouring temperature must be used and the molds designed to facilitate gradual cooling. A series of mold designs for various purposes is discussed and a cast Fe of the composition graphitic C, 2.9%; combined C, 0.4%; Si, 1.5%; P, 0.5%; S, 0.05%; Mn, 0.9% is suggested. For casting under pressure, the most important factors are the accuracy of manufacture of the different component parts of the molds, and the provision of adequate vent holes to avoid bubble formation. The best material is Cr-V steel of composition: Cr, 2.1%; V, 0.35%; C, 0.4%; Mn, 0.65%; Si, 0.1%. Such a steel may give 5000-8000 castings, but for larger quantities W steels of the type C, 0.07%-0.88%; Si, 0-0.2%; Mn, 0-0.5%; W, 8-18%, Cr, 2.5-6.5%; Mg, 0-2.5% V, 0-1.50%; Mo, 0-6% is recommended. It is concluded that casting has not yet been perfected and considerable progress both in construction of molds and the composition of the alloys used for them is desirable. WHB (12b)

Fluidity of Cast Iron. N. N. Feigin. *Scientific Research Institute of Machine Building & Metal Treatment,* No. 7, 1931, Moscow, Russia.

The Curry method was used by the author to measure the running qualities of molten metals. Fluidity of molten metals is shown to be directly influenced by the pouring temperatures as well as other factors such as metal composition, etc. Metal may be hot and at the same time not fluid on account of the presence of gases, oxides or slag inclusions. The gases liberated during solidification as well as oxides or other impurities present in the molten metal prevent undercooling effects and therefore, affect fluidity. The melting point of iron oxides is high and due to this fact itself should have a certain effect on the fluidity of cast iron. A clean metal, therefore, possesses greater fluidity than dirty metal. 16 heats of cast iron, 3 heats of Sn-bronze and 2 heats of steel were made. It was found that Curry's method was not suitable for steel. Dry and green sand molds were employed. Hand molding was employed by the same molder throughout all the tests. Moisture of green sand was 5-7%, permeability 20-30, and compressive strength was 0.15-0.20 lbs./in.^{2} At each pouring temperature a dry sand mold was cast first and followed by pouring green sand mold. The temperature measurements were made by means of an optical pyrometer. This method, the author admits, was unsatisfactory for measuring the temperature of molten bronze. On the other hand, he states, a thermocouple inclosed in the protective tube gave too great a lag in readings. *Experiments with Cast Irons:* Although the same cupola charge was maintained during this investigation, the chemical analysis of different heats was quite different. The compositions of some of the most typical heats of cast iron used in this investigation are given in Table 1.

Element	%					
C	3.65	3.64	3.51	3.61	3.53	3.29
Si	2.57	2.67	2.96	2.92	3.12	2.48
Mn	1.20	1.35	1.84	0.85	1.05	0.93
P	0.13	0.70	0.60	0.41	0.33	0.50
S	0.11	0.099	0.053	0.086	0.063	0.11

5 dry and 5 green sand molds were cast from each heat. Diagrams of each heat were drawn. From the fluidity data of these individual heats, an average fluidity of various cast irons was calculated and average diagram was drawn.

Table 2—Fluidity of Cast Iron.

Pouring Temperatures °C	Average Lengths of Spirals Cast of Different Cast Irons Expressed in Number of Divisions of Curry's Spiral	
	Dry Sand Mold	Green Sand Mold
1340	19.50	17.25
1320	20.33	19.17
1310	20.00	15.50
1300	18.50	16.87
1290	18.75	17.25
1280	16.94	15.44
1270	14.50	11.25
1260	15.83	13.00
1250	15.66	12.60
1240	13.25	11.50
1230	13.62	10.57
1220	11.33	10.57
1200	10.50	8.92
1180	7.62	6.50
1170	4.83	4.50

The maximum heating temperature of the melt is, of course, of a great importance, but as the author pointed out, the same charge and same cupola procedure were used during this investigation. The rate with which an average fluidity of cast iron decreased with a temperature drop was more pronounced in the dry sand molds than in the green sand molds. It was emphasized by the author that different fluidities may be obtained for the cast irons of the same chemical composition depending upon the previous history of production. It was observed, for instance, that when Fe-Si was added to a white iron, the iron had a tendency to solidify as a white iron, in which case the fluidity of such an iron will be quite different from the iron of similar composition but prepared under different conditions. *Experiments with Tin-Bronze:* The composition of bronzes examined is given in Table No. 3.

Table 3—Composition of Bronzes.

Bronze No.	Cu	Sn	P	Pb
		Per Cent		
1	86.0	13.5	0.03	0.15
2	89.0	10.52	0.02	...
3	93.58	5.75	0.05	0.12

The maximum heating temperature in all cases was around 1170°C. The results of this test are presented in Table 4.

Table 4—Results of Fluidity Test with Tin-Bronze.

Bronze No.						
1	Pouring Temperature °C	1150	1120	1100	1075	1050
	Number of divisions spiral ran in dry sand	22.5	19.0	18.0	11.5	12.0
	Number of divisions spiral ran in green sand	15.0	13.0	11.0	...	...
2	Pouring Temperature, °C	1140	1130	1110	1060	
	Number of divisions spiral ran in dry sand	13.0	10.0	10.0	13.0	
	Number of divisions spiral ran in green sand	10.0	9.0	8.0	10.0	
3	Pouring Temperature, °C	1120	1110	1100	1090	
	Number of divisions spiral ran in dry sand	7	7	5	3	
	Number of division spiral ran in green sand	5	5	4	2	

In all cases a higher fluidity was obtained with the dry sand molds than with the green sand molds. The fluidity of bronze increased with an increase of tin content. AIK (12b)

Rolling (12c)

Repairing Rolls in Aluminum Rolling Mills by Hand Polishing (Die Herrichtung der Walzen in Aluminium-Walzwerken durch Handschleifen). R. J. Anderson. *Metallwirtschaft,* Vol. 10, Nov. 27, 1931, pages 897-898.

In rolling Al and Al alloys into sheet and strip it is necessary to keep the rolls polished, as any cracks, holes, dents or irregularities in the rolls produce a rough surface on the soft Al. In hot rolling, heat cracks often form and a deposit of Al powder from the material being rolled builds up on the rolls. This also causes a rough surface on the sheet. If the rolls are deeply cracked they must be removed and polished on machines, but small cracks and the deposit can be removed by polishing by hand. The deposit can be kept to a minimum by scrapers on the rolls. For hand polishing, a 3x4 in. piece of hard wood is used, tapered at one end to approximately the radius of the rolls. This is covered with a mixture of grease and emery or alundum. The rolls are set about ¾ in. apart and rotated at high speed and the polishing wood is pressed against the rolls and moved sideways back and forth until the rolls attain the desired polish. CEM (12c)

Aluminium Sheet Production. Part IX. The Hot Breakdown Operation. Part X. Hot Mills. Robert J. Anderson. *Metallurgia,* Vol. 4, Aug. 1931, pages 117-118; Sept. 1931, pages 149-151; Oct. 1931, pages 173-174, 176; Nov. 1931, pages 21-22, 26; Dec. 1931, pages 37-38,40.

Continuations of a series of articles giving a detailed description of aluminum sheet fabrication. JLG (12c)

Investigation of Cold Rolled Steel V2A. G. W. Akimoff. *U. S. S. R.,* No. 404—*Scientific-Research Department Trans Central Aero-Hydrodynamical Inst.* No. 59. Moskow, 1930.

The object of this investigation was to (1) study the possibility of improvement of the mechanical properties of V2A steel by means of cold working alone; (2) study the influence of the cold work on the chemical stability of steel in the sea water and in the acids; (3) study the structural changes resulting from the cold rolling of steel. Hot rolled Krupp's sheet steel, grade V2A, was investigated. The thickness of the sheets was 1mm. and 2mm. Chemical composition of the steels used in this investigation was as follows:

Type	C	Cr	Ni	Si	Mn
No. 13 (2 mm.)	0.11	18.35	8.96	0.66	0.35
No. 10 (1 mm.)	0.13	18.20	10.06	0.55	0.40

The sheets were cold rolled and the following 2 series were obtained:

SERIES 1

	Original material	Cold rolled material		
	13	13/1	13/2	13/3
Thickness of sheet in mm.	2.2	1.55	1.0	0.52
Reduction in %	0	30	55	76

SERIES 2

	Original material	Cold rolled material			
	10	10/1	10/2	10/3	10/4
Thickness of sheet in mm.	1	0.84	0.62	0.42	0.37
Reduction in %	0	16	38	58	63

The investigation showed that the cold rolled sheet steel of V2A type is possessing both high mechanical properties and high chemical stability and is of great value for various structural purposes. These cold rolled steels may be classified as follows:

1. *Steel reduced by cold deformation from 25% to 40%.*

The mechanical properties are: ultimate strength = 100 to 120 kg./mm.^{2}, the proportional limit = 75 to 90 kg./mm.^{2}, elongation 18 to 12%.

2. *Steel reduced by cold deformation from 60% to 75%.*

The mechanical properties are: ultimate strength = 140 to 150 kg./mm.^{2}, the proportional limit = 110 to 130 kg./mm.^{2}, elongation = 3% to 5%. The steel can be bent, and bends of small radii can be obtained. Elimination of the heat treatment makes it possible to obtain smooth unbuckled sheets. Seamless tubing can be made by cold rolling to the dimensions required, after the first passes were made in hot condition. Metallographic examination showed that the highly deformed metal possessed a normal structure. No transformation of the solid solution and no precipitation of carbides during the cold deformation were observed. All the steels, hot rolled as well as cold rolled, were perfectly stable in sea water and in 20% HNO_3 solution, both at 70°-80° C and at lower temperatures. The steels of type No. 13 are subject to corrosion in cold hydrochloric acid; the corrosion increases uniformly with the degree of cold deformation. In case of steels of type No. 10 treated with hot hydrochloric acid there is no pronounced difference in the rate of corrosion; no definite relation is established between the rate of corrosion and the degree of deformation. In the case of steels of both types in hot sulphuric acid it was found that: (1) the original hot rolled metal is subject to intense corrosion; (2) the cold rolled metal is perfectly stable when reduction is 16% (type No. 10) and 30% (type No. 13); (3) when the amount of reduction is over 30% there was a severe corrosion; the loss in weight being about twice as large as that of the original material. In a 3% NaCl, 3% H_2O solution there was a slight corrosion; the intensity was reduced by nearly half for the cold rolled material with a 30% reduction (class $\frac{13}{1}$ steel) as compared with the hot rolled metal. A greater corrosion was obtained when reduction was above 30%, so that for 76% reduction the rate of corrosion was about equal to that of the original hot rolled metal. AIK (12c)

The Process of Wear of Turning Tools Made of High Speed Steel and Straight Carbon Steel (Ueber den Abnutzungsvorgang von Drehmessern aus Schnelldrehstahl und Kohlenstoffstahl. F. Rapatz & H. Pollack. *Stahl und Eisen,* Vol. 51, Dec. 10, 1931, pages 1538-1539.

In rough turning with high speed steel tools, the wear does not take place at the edge of the tool but somewhat behind it. It is generally assumed that tools of carbon steel do not show such type of wear; wear starts at the edge of the tool. Comparative tests with carbon and high speed steel tools indicate that the above assumption does not hold true. In rough turning, grooves are gradually formed behind the edge on both carbon steel and high speed steel tools. The appearance of the grooves depends upon the speed of cutting. In smoothing, the wear starts on the edge for both the carbon steel and high speed steel tool. GN (12g)

Judging the Surface Condition in Machining Tests. (Die Bewertung der Oberflächengüte bei Zerspanungsversuchen.) K. Schmiz. *Stahl und Eisen,* Vol. 51, Nov. 12, 1931, pages 1402-1403.

In tests to compare the smoothness of machined surfaces of steels, the author used an instrument described by G. Schmalz, *Zeitschrift Verein deutscher Ingenieure,* Vol. 73, 1929, pages 1461-1467, and developed by the Institute für Messtechnik und Austauschbau of the Technische Hochschule Dresden. Shafts of 8 different steels having diameters of about 38 mm. were used in turning with depths of cut of 1 mm. and feeds of 1.15 mm. Every steel was tested with cutting speeds of 12, 24, 48, 70 and 96 m./min. The surfaces appearing at the various speeds are shown and in a diagram the uneveness of the surface was plotted against the speed of cutting. The results are as follows: The tile-shaped chips disappear with the steels containing a higher content of carbon, or better, having a higher tensile strength at lower cutting speeds than with the steels of a lower tensile strength. Former investigations revealing that the smoothness of the machined surface improves with increasing cutting speed are confirmed. GN (12g)

Economical Boring and Milling. (Wirtschaftliches Bohren und Fräsen.) H. J. Stoewer. *Maschinenbau,* Vol. 10, Feb. 19, 1931, pages 117-119.

Economical boring and milling operations may be obtained in practice by using hard metal tools, correctly shaped tools and machines, and carefully installed machines and tools, by standardization and by use of knowledge based on scientific tests. MAB (12g)

New Tests on Cutting of Tools. (Nouveaux essais sur la coupe des outils et sur l'usinage.) L. Persoz. *Aciers Speciaux Métaux et Alliages,* Vol. 6, July 1931, pages 333-346.

Translation of article by F. Schwerd, *Stahl und Eisen,* Vol. 51, Apr. 16, 1931, pages 481-491. It is not possible to follow with the eye exactly how the high speed machine tool cutting operation proceeds. By means of a cinematographic camera, which was developed by C. Cranz in Berlin, the author was able to get a clear picture at a speed of 10 exposures per 1/1000 sec., with illumination of 1/1,000,000 sec. A great number of photographs are reproduced showing cutting tools in operation on steel and cast iron, working at different speeds, different cutting angles, and varying depths of cut. See also *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 19. GTM (12g)

Machinability Properties of Some Cold Drawn Steels. (Bearbeitbarkeitseigenschaften einiger Kalt gezogener Stähle.) F. Rapatz. *Stahl und Eisen,* Vol. 52, Jan. 21, 1932, pages 71-72.

The writer summarizes the results of others, making graphs for all properties of machinability by the various methods. Brinell hardness, moment of rotation, feed pressures, and depth of penetration in drilling, cutting pressures in planing, etc. for 13 steels. Compositions of an ordinary and easily machinable steel are:

	C	Si	Mn	P	S	Cr	Mo
(1) Ordinary	0.06	0.18	0.31	0.012	0.022	13.35	....
(2) Easy to machine	0.09	0.14	0.30	0.016	0.46	15.15	0.25

Cause for this property is explained by sulphide lines in crystal structure, produced by molybdenum sulphide. However, data is not presented regarding rates of cutting and standards. DTR (12g)

Drawing & Stamping (12h)

The Bessemer Process and its Product. R. S. McCaffery. *Rolling Mill Journal,* Vol. 5, Oct. 1931, pages 675-676.

A brief discussion of recent developments: Bessemer steel wires, for instance, can be reduced from No. 5 gage to No. 19 or 20 gage without annealing, whereas open-hearth steel would require two or three anneals for the same reduction. The precautions to observe in order to turn out a flawless material are discussed. Ha (12h)

Thin Strip Steel for Deep Drawing. H. T. Morton & I. A. Rummler. *Metal Stampings,* Vol. 4, Oct. 1931, pages 819-820, 840.

The test methods for judging thin sheets for deep-drawing are discussed. Hardness (Brinell) test, cup-forming tests and bending tests, in their relative appropriateness, are treated. A small percentage of strips from each shipment should, also, be examined for surface conditions, size tolerances and internal defects. The analyses of 2 steels, S.A.E. 1010 cold rolled and S.A.E. 1010 hot rolled, both suitable for the process, are given. Ha (12h)

Deep Drawing of Sheet Metal on Wooden Molds. A New Shaping Method for the Manufacture of Coach Parts. (Blechziehen über holzerne Formen. Ein neues Streckverfahren zur Herstellung von Karosserieteilen.) O. Kühner. *Maschinenbau,* Vol. 10, Jan. 1, 1931, pages 7-8.

The manufacture of relatively small sheet-metal parts under conditions where a draw bench would be uneconomical is discussed. The sheet, held at each end is forced into a mold at the center by means of a wooden plunger. MAB (12h)

DEFECTS (13)

The Nature of Defective Laminations in Wrought-Iron Bars and Chain Links. H. J. Gough & A. J. Murphy. *Engineering*, Vol. 131, May 15, 1931, pages 653-655; discussion, May 22, 1931, page 680.

Condensed from Communication from the National Physical Laboratory, read before the Iron and Steel Institute, London, May 8, 1931. See *Metals & Alloys*, Vol. 2, Nov., 1931, page 273. LFM (13)

On the Cause of Inverse Segregation. Kei Iokibe. *Science Reports of the Tohoku Imperial University*, Sendai, Japan, Vol. 20, Oct. 1931, pages 608-648.

After an exhaustive review on previous work on inverse segregation the author describes his experiments with electrolytic Cu, electrolytic Zn, and of 99.9% pure Sn. From the results of the detailed examination of contraction at various points of the chill cast ingots the mechanism of inverse segregation has been explained as follows: The solidification shrinkage of primary crystals at the outer portion of the ingot causes the outward movement of the mother liquid from the inner portion. The liquids thus flowing toward the outer surface become impoverished with respect to the component of higher melting point, i.e., relatively pure, primary constituents are left in the center causing the enrichment of the secondary component at the outside. 37 references. Ha (13)

Non-metallic Inclusions in Steel. Charles H. Herty, Jr. (Pittsburgh Station, U. S. Bureau of Mines). *Transactions American Society for Steel Treating*, Vol. 19, Nov. 1931, pages 1-40; *Metal Progress*, Vol. 20, Oct. 1931, pages 37-42.

Sixth Campbell Memorial Lecture delivered before the Boston Convention of the Society, Sept. 1931. 22 references are cited. Non-metallic inclusions in steel have been a direct cause of great expense to steel makers in inspection and rejection. The sources of inclusions and methods of manufacture suited to their elimination are pointed out. A study of S and O free alloys must be made to form a base line for comparison of commercial steels and steel-making methods. Available data point to large inclusions as most harmful to the physical properties. The importance of oxides and sulphides where certain metallographic structures are to be obtained or avoided is discussed. The fact is emphasized that the steel consumer often imposes an impossible burden in specifications on the maker. Coöperation between consumer and maker is urged as a solution of this situation to the end that the steel maker may use the methods and materials best suited to the production of the quality of steel required by the consumer. WLC (13)

A New Type of Inclusion in Cast Iron and its Relation to Silicon and Manganese Content. F. J. Cook. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Oct. 1931, pages 423-439.

See *Metals & Alloys*, Vol. 2, Nov. 1931, page 274. (13)

Failure of Steel in Machine Parts. L. T. Holt. *Steel*, Vol. 89, Aug. 20, 1931, pages 31-33.

Some of the principal causes of failures are caused by notch fatigue, insufficient heat treatment, tool marks, and the presence of inclusions. Means of detecting them by macrographic and micrographic testing are discussed. Ha (13)

Formation and Elimination of Non-Metallic Inclusions in the Acid Open-Hearth Process. C. H. Herty, Jr. & J. E. Jacobs. *Transactions American Society for Steel Treating*, Vol. 19, Jan. 1932, pages 271-288; *Blast Furnace & Steel Plant*, Vol. 19, Apr. 1931, pages 553-556; May 1931, pages 683-686.

Five references are cited. The paper gives a brief summary of acid open-hearth furnace practice. A study of the elimination of the non-metallic matter derived from the charge shows it to be partially effected by the oring but that the addition of spiegel in the ore facilitates their elimination. Use of a Mn-Si alloy followed by small additions of Mn effectively eliminates SiO_2 inclusions coming from the bottom due to the boiling action. At the ending of the working period the oxide content of the bath can be controlled by changes in the slag composition, viscosity and temperature. Mn-Si alloy gives a much cleaner steel in the furnace than Mn and Si alloys separately. Holding the ladle and pouring on the cold rather than the hot side is beneficial in the elimination of non-metallic matter. Ha + WLC (13)

Loose Wheel Tires of Locomotives. (Ueber lose Radreifen an Lokomotiven.) Ludwig Koch. *Organ Fortschritte des Eisenbahnwesens*, Vol. 86, Feb. 15, 1931, pages 118-122.

Observations of the German State Railroads are communicated according to which it is not a rare occurrence that the tires on the wheels of locomotives become loose. The reasons for this rather costly occurrence can not be cleared up at present. Faulty treatment in the shop in pressing the tire on, and the greater effect of modern brakes can be considered as reasons. It is recommended to specify exact dimensions for wheel and tire for shrinkage the latter on the wheel and to see that they are observed in the shop. Ha (13)

Notch Load (Die Entlastungskerbe). A. Thum & S. Berg. *Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 2, Oct. 1931, pages 345-351.

The detrimental effect of notches which are unavoidable and always present in structures and which, due to vibrating loads, produce a reduction in the endurance strength, may be modified by the use of supplementary notches adjacent to the notches occasioned by the construction. By long-time notch tests it is shown how this is carried out. Model tests show further evidence of the satisfactory effect of additional notches and bores by alleviation of the thickness of the lines of stress. MAB (13)

Effect of Inclusions on Impact Strength of Steel. A. B. Kinzel & Walter Crafts. *Rolling Mill Journal*, Vol. 5, Feb. 1931, page 90.

Abstract of a paper presented at a meeting of the American Institute of Mining & Metallurgical Engineers, held in New York, week of Feb. 16, 1931. See *Metals & Alloys*, Vol. 2, July 1931, page 136. JN (13)

CHEMICAL ANALYSIS (14)

The Volumetric Determination of Tin in White Antifriction Metals. (Sulla determinazione volumetrica dello stagno nei metalli bianchi antifrizione.) D. Lombardo. *La Metallurgia Italiana*, Vol. 24, Jan. 1932, pages 10-20; *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 13, 1931, page 883.

Study of reduction to stannous Sn, in a CO_2 atmosphere, by Pb (containing 3% Sb) and by Armco iron, prior to titration by iodine. Fair results are obtained with reduction by Pb if the empirical factor 0.00599 g. Sn per cc. of n/10 iodine is used. With Fe as reducing agent the theoretical factor gives satisfactory results in alloys of less than 38% Pb. In higher Pb alloys results may be 0.20-0.35% low. The Sb content of the solution should be, or brought to, at least 12 parts Sb to 100 Sn. Copper up to 23% does not interfere, nor does As in amounts normally present. The determinations on which these conclusions are based are tabulated in detail. Ha + HWG (14)

On the Position of Uranium-Z in the Order of the Uranium Decomposition Succession (Ueber die Stellung des Uran-Z in der Uranzerfallsreihe). E. Walling (Kaiser Wilhelm Institut für Chemie, Berlin-Dahlem). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 14, Oct. 1931, pages 290-296.

A quantitative Uranium-Z determination showed that UX_1 represents the parent substance of U-Z. EF (14)

The Practice of Spectrum Analysis with Hilger Instruments. Compiled by F. Twyman. Adam Hilger, Ltd., London, 1931. Cloth, 6 x 9¾ inches, 53 pages. Price 3s. 6d.

This paper is an attempt to sell spectrographic analysis and incidentally the publisher's equipment to all interested in chemical analysis. Very little direct advertising is used, however, only occasional reference to the model of instrument best suited for a particular type of work. Many references to the literature are given in the text, followed by a bibliography of 78 publications. The booklet is composed of 6 chapters which include considerable pertinent and condensed information on all branches of spectroscopy and is well worth its low cost. C. P. Larrabee. (14)-B-

The Determination of Silver in Gold Bars. (Silberbestimmung in Goldbarren.) F. Michel. *Chemiker Zeitung*, Vol. 55, Sept. 23, 1931, pages 731-732.

Usually Ag is determined by the difference between the Au + Ag and the Au determinations. This causes errors up to 0.01. A number of ¼ g. samples of synthetic alloys of pure Au, Ag and Cu were analyzed. In alloys low in Au, the Ag result was low and in alloys high in Au, the Ag result was high. This was at least partly due to the quantity of Pb used in the cupel. For accurate results, analysis by the usual method is recommended; then make up a synthetic alloy of the same composition and check it by the same method using the same quantity of Pb. If the Ag result in the sample was lower than in the check, subtract the difference from it and vice versa. CEM (14)

A New Method of Checking the Catalytic Effect of the System Pd-H by Means of Resistance Measurements (Ueber eine neue Methode zur Verfolgung der katalytischen wirkungen des Systems Palladium-Wasserstoff mit Hilfe von Widerstandsmessungen). C. A. Knorr (Technische Hochschule München). *Zeitschrift für physikalische Chemie*, Abt. 2, Vol. 157, Nov. 1931, pages 143-163.

A modified method of electric resistance measurement was employed and the factors governing the hydrogen liberation from Pd were studied. EF (14)

The Chemistry of Rhenium, II. The Determination of Rhenium as Thallium Perrhenate. (Beiträge zur Chemie des Rhenium, II. Die Bestimmung des Rheniums als Thallium—Perrhenate.) F. Krauss & H. Steinfeld. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 197, Mar. 24, 1931, pages 52-56.

The production of thallium perrhenate is described and its properties are discussed. Instructions for the determination of rhenium as thallium perrhenate are given. Ha (14)

The Cathode Ray Tube in X-Ray Spectroscopy and Quantitative Analysis. Gorton R. Fonda & George B. Collins. *Journal American Chemical Society*, Vol. 53, Jan. 1931, pages 113-125.

The application of the cathode ray tube to the quantitative analysis of alloys is shown by both the ionization and the photographic methods. MEH (14)

The Conditions for Precipitation of Polonium and Some of Its Complex Dérivatives. I. Centrifugal Study of the Reactions of Precipitation of Various Compositions of Polonium without Adding a Precipitator. (Sur les conditions de précipitation du polonium et sur quelques-uns de ses derives complexes. I. Etude, par centrifugation, des reactions de precipitation de divers composes du polonium sans addition d'entraineur.) M. Guillot. *Journal de chimie physique*, Vol. 28, Jan. 1931, pages 14-41.

Every time the precipitation of polonium with a very small quantity of a derived foreign metal is practically completed, an insoluble derivative of polonium is formed, precipitated under the same experimental conditions. These conditions are: (1) When polonium is soluble, but the precipitator is sufficiently crystallized to see evidence of solid solution; (2) When polonium is insoluble and the total precipitation is composed of a metal insoluble in water but soluble under any other chemical reaction in another neutral solvent in which it can crystallize easily. Hence a composition of trivalent polonium in insoluble, can be totally precipitated by a composition of a bivalent metal, with the condition that both be extremely insoluble. MAB (14)

Separation of Nickel from Cobalt Metal or Ferro-Cobalt. H. A. Kar. *Chemist-Analyst*, Vol. 20, Mar. 1931, page 15.

Dissolve 1 g. sample in 50 cc. HNO_3, Sp. Gr. 1.2, neutralize with NH_4OH and add 50 cc. excess. Add 10-15 g. NH_4SO_4 and boil 10 minutes. Filter off $Fe(OH)_3$ and MnO_2 and wash. Cool, add 200 g. NH_4Cl and dilute to 400 cc. Add 1% dimethyl glyoxime solution in alcohol and allow precipitate to settle one hour. Filter and redissolve in HNO_3. Repeat the precipitation as before. Filter on paper and ignite in a weighed Pt crucible, slowly at first, finally at red heat, and weigh NiO. NH_4SO_4 oxidizes $Co(OH)_2$ to $Co(OH)_3$ which does not precipitate. CEM (14)

ECONOMIC (16)

Efficiency in Steel Plants (Betriebswirtschaft in Energiebetrieben.) G. Veit. *Stahl und Eisen*, Vol. 51, Oct. 29, 1931, page 1344; Nov. 5, 1931, pages 1379-1380; Nov. 12, 1931, page 1407.
It is shown how a careful investigation of the conditions of operation of a large German steel plant revealed an excessive consumption of water, steam and electric current. After improving the conditions, the costs could be essentially decreased; the water cost was reduced by about 60%, the cost of steam, by 26% and the cost of electric current by 14%. GN (16)

The Italian Steel Foundry Industry in 1931. Guido Vanzetti. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, pages 29-30.
A brief article, accompanied by 2 photographs, dealing with steel foundry trade in Italy during 1931. OWE (16)

Mercury in 1930. Paul M. Tyler. *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*. Part 1, pages 31-56, Oct. 28, 1931.
Hg production in 1930 in the U. S. was 21,553 flasks (76 lb. each), a decrease of 9% from 1929. California was the leading producing state (11,451 flasks), Nevada was second (3,282), Oregon third (2,919) and Washington fourth (1,079). Imports for consumption were 3,725 flasks. AHE (16)

The Pig-Iron Trade in 1931. D. N. Turner. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, page 19.
A brief summary, with tables, covering the British production, imports and exports of foundry pig-iron during 1931. OWE (16)

The Belgian Foundry Industry in 1931. Gustave Masson. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, page 37.
General. OWE (16)

Production Planning (Productionsplanering). Robert Larsson. *Jernkontorets Annaler, Proceedings of the Annual Meeting*, May 30, 1931, Vol. 114, 1931, pages 7-48.
Advocates organization of a special planning department, subordinate to managing director's office, for the purpose of coördinating production and relieving the works-engineers of a great deal of office work. HCD (16)

Influence of the Construction of Castings on the Cost of Manufacture. (Einfluss der Konstruktion von Gussstücken auf den Herstellungenspreis.) Heinrich Tillmann. *Maschinenbau*, Vol. 10, Aug. 20, 1931, pages 525-529.
The "right and wrong" ways of constructing castings are given, and the differences are clearly emphasized to show how the models or the castings can be manufactured cheaper. The individual things which go to make the castings cheaper and the value of standardized operating of the units in the construction of models and in foundry practice are brought out. Suggestions for further combined operations are given. MAB (16)

"Dull" Year's Iron Ore Train Reaches Twice Across Continent. A. J. Hain. *Steel*, Vol. 88, Jan. 29, 1931, pages 35-37, 53.
The Lake Superior district shipped 47,187,661 gross tons of iron ore in 1930. This is 28% less than in 1929 but only 9% less than the annual average for the previous 10 yrs. The author gives a set of tables and charts showing the amounts of ore shipped from the individual mines in each range of the Lake Superior district in 1929 and 1930. JN (16)

Mineral Resources of the United States, 1930, Summary. O. E. Kiessling, *et al.* *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*, Part 1, Nov. 9, 1931, pages A1-A120.
The value of all mineral products in the U. S. in 1930 was \$4,810,400,000, a decline of 18% from 1929 and the lowest figure since 1922. Mineral fuels declined 14%, metals 33% and non-metals 12%. Cu, Fe, Pb, Ag and Zn declined 30-49%. Au alone among the metals gained. Natural gas production increased. Quantity and value gains were registered by As, borates, Br, Ca-Mg chloride, fuller's earth and phosphate rock. Output alone gained for pyrite, asbestos and mica. Detailed figures of quantity and value for 1929 and 1930 are given tabularly for each product. AHE (16)

Soviet Copper Development. Correspondence from M. Karashov, Moscow, U. S. S. R. *Metal Progress*, Vol. 21, Jan. 1932, pages 69-70.
Describes Kounrad copper deposits comparable to Utah deposits in the United States. Estimated production of these deposits by 1933 is 1,000,000 lbs. of copper daily. WLC (16)

Arsenic, Bismuth, Selenium and Tellurium in 1930. V. C. Heikes. *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*, Part 1, Nov. 4, 1931, pages 25-30.
Production of As as As_2O_3 in the United States in 1930 was 17,057 short tons. Al was a by-product from smelting Cu and Pb ores. Bi was reported recovered at but 1 refinery in 1930. 3 companies reported a 1930 output of 454,769 lbs. of Se. Te production was 14,095 lbs. AHE (16)

Determination of Pipe Diameters for Maximum Economy. C. W. Harris. *Engineering News Record*, Vol. 106, Jan. 15, 1931, page 101.
Determination of the economic size of pipe for long lines has generally been treated as a problem depending on specific conditions of the individual case. The author shows that the principal factors involved in economic studies are independent of local conditions. From the theoretical investigation, it can be concluded that, for minimum weight and constant factor of safety, the size of any high pressure steel pipe should vary throughout the profile so that the diameters at all successive points will be inversely proportional to the seventh root of their respective pressure heads. Ha (16)

Iron Mine Operators Prepare for More Active Season. A. J. Hain. *Steel*, Vol. 88, Jan. 8, 1931, pages 46-48.
A discussion of the changes in leases, ownership and control of mines in the Lake Superior region during 1930 with notes on drilling operations, construction of new shafts and opening of new mines. JN (16)

Progress in Copper Production. *Metallurgist*, Mar. 1931, pages 43-44.
An extended abstract of Dr. Ernst Hentze's review of the developments in copper production from 1920 to 1930 appearing in the first issue of *Metall und Erz* for 1931. VVK (16)

The British Steel Foundry Industry in 1931. J. Deschamps. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, page 20.
A brief summary, with tables, covering British production, imports and exports of steel castings during the year 1931.

Platinum and Allied Metals in 1930. Hubert W. Davis. *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*, Part 1, Nov. 16, 1931, pages 99-112.
In 1930, 385 troy oz. of crude Pt was produced in Alaska, 129 oz. in California, and 13 oz. in Oregon, a total of 527 oz. for the U. S. Domestic refiners recovered 37,780 oz. Pt, 3801 oz. Pd, 1468 oz. Ir, 334 oz. osmiridium and 119 oz. of other Pt metals, a total of 43,502 oz. Recovery from secondary sources was Pt 33,787 oz., Pd 7426 oz., Ir 4,354 oz., and others 1,749 oz., a total of 47,316 oz. AHE (16)

Iron Ore, Pig Iron and Steel in 1930. Hubert W. Davis. *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*, Part 1, Nov. 19, 1931, pages 57-98.
In 1930, production of Fe ore decreased 20% and shipments 27% from 1929. The output of pig Fe (including ferrous alloys) decreased 25%. For the first time since 1927, building and construction was the leading consumer, using 19% of the output (16.5% in 1929). The automobile industry used 15.5% (18% in 1929) and railroads 15% (17% in 1929). Domestic output of pig Fe required about 60% of the capacity. Production of steel ingots was about 59% of the rated capacity. AHE (16)

Gold, Silver, Copper, Lead and Zinc in the Eastern States in 1930. J. P. Dunlop. *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*, Part. 1, Oct. 7, 1931, pages 17-23.
The production of Au, Ag, Cu, Pb and Zn in the Eastern States in 1930 increased over 1929 but owing to the lower prices of Ag, Cu and Zn, the value of the production of each and of the total for all 5 metals declined. Production was Au \$46,637; Ag 123,590 oz., \$47,582; Cu 38,232,031 lb., \$4,970,-164; Pb 16,734,000 lb., \$836,700; Zn 336,488,000 lb., \$18,126,878; and total \$24,027,961. AHE (16)

The Pig Iron Situation. E. J. Fox. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 75-76.
An urge for tariff protection for British pig iron. CHL (16)

Iron Mining in Spain (La Mineria De Hierra En Espana). Luis Barreiro. *Revista Minera*, No. 3289, Nov. 1931, pages 530-531.
An economic discussion of iron mining in Spain. Production of iron in thousands of tons from 1913 to 1930 inclusive; maximum, 1913, 9,861; minimum, 1921, 2,602; 1930, 5,408. This decrease is due to the number of miners employed: 1913—33,678; 1929—16,358. DTR (16)

Does the United States Need a Tariff on Copper? Percy E. Barbour. *Mining and Metallurgical Society of America, Bulletin* No. 222, Vol. 24, Dec. 1931, pages 94-102.
Discussing this question from the angle that the United States is the greatest Cu producer in the world and has invested very largely in the Cu industries in other countries, especially South America, the need for a tariff is denied.

Tin—Its Past, Present Plight, and Future. H. E. Ellefsen (Bolivia). *Mining Journal*, London, Vol. 176, Jan. 2, 1932, pages 5-6; Jan. 9, pages 21-22.
A general economic discussion. AHE (16)

The World's Silver Situation. W. Mont Ferry (Silver Producers Association). *Mining Congress Journal*, Vol. 17, Dec. 1931, pages 660-661, 669.
Presented at meeting of Western Division, American Mining Congress, September 1931. The buying power of half of the people of the world can not be destroyed without profoundly and adversely affecting world industry; the world's gold is inadequate to support the world's credit structure. Silver should be restored to its historic place as a basic money. Our so-called over-production is a myth; lack of distribution and destruction of buying power among people who are potential purchasers are the cause of all stagnation of international commerce. The use of silver as a recognized money is the only remedy in sight. DTR (16)

The Malleable Castings Industry in 1931. A. W. G. Bagshawe. *Foundry Trade Journal*, Vol. 46, Jan. 14, 1932, pages 37, 39.
A brief article dealing with the malleable castings industry in Great Britain during 1931. Particular attention is given to the use of rotary and semi-rotary furnaces for the melting of malleable iron, and the fact is noted that five or six of these furnaces, in which pulverized fuel will be employed, are being built in Great Britain and Europe at the present time. OWE (16)

The Automatic Increase of Price of the Liquid Iron at Insufficient Yield (Die automatische Verteuerung des flüssigen Eisens bei nicht genügenden Ausbringen). W. Bremer. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, pages 857-858.
By "yield" is meant the ratio of the weight of good castings to the weight of the charge. Tables and curves demonstrate that too small a yield increases the cost of the cold charge and the melting costs. It is emphasized that this reason for losses should be eliminated as far as possible.

Copper Consumption In The United States. *American Metal Market*, Vol. 38, Apr. 25, 1931, pages 2-3.
Reported by American Bureau of Metal Statistics. Use of Cu, industrially classified, in the U. S. in 1930. Also comparative diagram of consumption and domestic deliveries of refined Cu from 1920 to 1930. DTR (16)

The Group Bonus System. A. L. Ainsworth. *Canadian Foundryman*, Vol. 22, Oct. 1931, pages 15-16.
An article dealing with the application of the group bonus system in the De Forest Crossley plant at Toronto. OWE (16)

The Importance of Heat Balances and Heat Statistics in an Iron Works (Värmebalansers och värmestatistiks betydelse vid järnverk). Ake Anjou. *Jernkontorets Annaler*, Proceedings of the Annual Meeting, May 30, 1931, Vol. 114, 1931, pages 86-132.
An analysis is made of the heat losses in Swedish iron works and a plea is made for employment of a greater number of heat engineers as in German practice. In the discussion following the paper, it is pointed out that quality is so important a factor in Swedish steel products that too much emphasis can not be placed on heat economy. A very good discussion of German practice in heat control is given. HCD (16)

MISCELLANEOUS (20)

Coke Oven Design. G. W. J. Bradley. *Iron & Steel Industry & British Foundryman,* Vol. 5, Dec. 1931, pages 87-94, 102.

A discussion of the coking process dwelling on the essential conditions for the production of good coke, i. e. uniform heating of the oven together with a correct width of oven. The means of securing an even distribution of gas and air throughout the length of the oven are treated. 11 types of oven are dealt with as regards their differences in construction, while setting forth their claims for superiority. They are the Becker oven, the Collin oven, the Coppée Isothermal oven, the Gibbons Kogag oven, the Koppers oven, the Otto oven, the Piette oven, the Semet Solvay oven, the Carl Still oven, the Simon Carves oven, and the Wilputte oven. CHL (20)

Standardization—Transportation, Ferrous Metallurgy and Non-Ferrous Metallurgy Projects. American Standards Association. *American Standards Association Bulletin,* No. 60, Apr. 1931, pages 25-29.

List of specifications developed or being developed under A.S.A. procedure in these fields. 10 refer to electric railway rails and track materials. 18 refer to steel, wrought iron, Zn, zinc coatings, Cu, brass, bronze, solder and plumbago crucibles. HWG (20)

Patent Rights for Scientific Discoveries. C. J. Hamson. Bobbs-Merrill Co., Indianapolis, 1930. Cloth, 6 x 9¼ inches, 286 pages. Price $4.50.

This monograph won the prize for 1929 of the Linthicum Foundation. Linthicum was patent counsel for the U. S. Steel Corporation and lecturer on patent law at Northwestern University. As a memorial, friends established the prize fund for research in patent law. The 1929 topic was "Scientific Property." Hamson is an English lawyer.

Some French savants advanced the idea that scientists discovering scientific principles of the type not now patentable should be rewarded by industrial firms that, in the course of time, manufacture anything that is an outgrowth of the discoveries. Radio, had such a scheme been in vogue, would now pay tribute to all the many scientists whose work underlies the industry. It is claimed that in France a bill securing rights of scientists to such tribute is "very likely to be passed in the near future." Since science is international, the matter has been put up to the League of Nations, which has been studying it for 7 years, its experts invariably approving the fundamental proposition. The International Union of Pure and Applied Chemistry actively advocates the scheme. Partial governmental approval of the proposal forwarded by the League of Nations was indicated by the replies of Belgium and Brazil only. The National Research Council of the United States considers that proprietary right over discoveries is not realizable and doubts that it is desirable.

Hamson discusses the history of the project, recognizes that so many discoveries are utilized in the manufacture of any modern product, and the time (50 years) suggested for the period in which tribute is to be paid, so long, that the only way a firm could do business under such a scheme would be to insure itself against litigation and exactions by buying a blanket right to utilize all discoveries.

Hence, he proposes an international corporation to administer the scheme. All suggestions are complicated and hazy and though Hamson argues that a workable scheme could be evolved, very few of the opinions he cites agree with him.

The scheme seems aimed to involve compulsory tribute designed to be used to encourage research. It appears entirely calculated to be an unmitigated nuisance to industry and quite opposed to the American way of doing things. There does not seem any immediate danger of international action and the fact that it is to some degree sponsored by the League of Nations would surely subject the scheme to careful study before even the most radical U. S. Congress would adopt it.

The preface says, "The unorganized army of men of science everywhere find here opened before them a prospect of just and material reward. The cohorts of the Patent Bar are those who can formulate and administer the measure when it becomes accepted. To these 2 classes in the community a vast field of possibilities is opened. It is time that the professional men of America awaken and take a hand in the debate."

It would appear that any such attempt on the part of patent lawyers to saddle industry with more difficulties and litigation analogous to those already imposed by our faulty patent system should be resented and opposed alike by industry and science. Voluntary coalition for support of pure research is one thing. Exaction of involuntary tribute is quite another. The scheme is unwieldy and unworkable without huge costs for bureaucratic administration and for litigation. It would surely delight the average patent lawyer to have a whole new field of opportunities for litigation. The book might well be read by scientists so they may be ready to combat the impractical visionaries and the "cohorts of the Patent Bar" who may seek to foist such schemes upon industry. H. W. Gillett (20)-B-

The Electric Precipitation of Dust and the Electric Cleaning of Blast-Furnace Gases (La précipitation electrique des poussieres et l'épuration électrique des gas de hauts fourneux). Keraly. *L'Industrie Electrique,* Vol. 40, Apr. 25, 1931, pages 173-180.

The principle of electric precipitation is explained and the history of its development is briefly described. A modern installation of 240,000 in.^{3}/hr. is described in detail; the best arrangement of such a plant and the electric equipment is discussed. Ha (20)

Investigation of Different Methods to Determine the Roughness of Metallic Surfaces (Untersuchung verschiedener Methoden zur Bestimmung der Unebenheiten (Rauhigkeiten) von Metallflächen). W. Kiesewetter. *Feinmechanik und Präzision,* Vol. 39, Dec. 1, 1931, pages 211-215.

A method of making a perfect cast of a surface and an optical method to make visible and record the unevenness on it is described and illustrated by many examples. Ha (20)

Patent Law for Chemical and Metallurgical Industries. A. W. Deller. Chemical Catalog Co., Inc., New York, 1931. Cloth, 6 x 9 inches, 483 pages. Price $6.00.

Most books on patent law and procedure are pretty hard reading for the metallurgist. This one, however, draws so many of its examples from the metallurgical field that it can be readily followed.

The reviewer does not agree with the opinion quoted in the book, of a Japanese investigator sent over to look into the U. S. Patent System who ascribed the greatness of the U. S. to that system. But since we are saddled with the system and must play the game according to the rules, it is necessary to know what the rules are. This book is, to the metallurgist, at least, the most useful one of its type we have yet seen, for it explains the rules from the metallurgist's point of view and not exclusively from a lawyer's point of view.

It covers the history, theory and nature of patents, classes of patentable inventions, persons entitled to patents, principles of patentability, acquisition and termination of patents, remedy of defective patents, form and construction, infringement and infringement suits, ownership of patents, commercial phases and foreign patents.

An appendix of miscellaneous statistics covering such things as production of metals and minerals and a tabulation of the developed and potential interpower of the world does not seem very germaine to the subject of the book, but at least does no harm. H. W. Gillett (20)-B-

The Catalytic Reduction of Carbon Monoxide under Ordinary Pressure. IX. Tests with the Co-Cu-MgO-Catalyzer. X. Tests on the Influences of Some Materials on the Catalytic Action of the Co-Cu-MgO-Catalyzer. (Ueber die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck. IX. Versuche mit dem Co-Cu-MgO-Katalysator. X. Versuche über die Einflüsse einiger Stoffe auf die katalytische Wirkung des Co-Cu-MgO-Katalysators.) K. Fujimura. *Scientific Papers of the Institute of Physical & Chemical Research,* Vol. 17, Nov. 1931, page 11-21.

The most suitable catalyzer for the synthesis of petroleum has been found to be the Co-Cu-Mn catalyzer where the constituents are present in the ratio 3:1: (15% of Co); the activity of this catalyzer was studied with respect to its volume and with additions of other elements. Only thorium or uranium improved its activity, the latter in an amount of 8:1:2:0.4 (in Co-Cu-Mg-U). Ha (20)

Unknown Factors of Safety Present in the Quality and Transformation Processes of Light Metals (Facteurs de sécurité méconnus résidant dans la qualité et les procédés de transformation des métaux légers). R. de Fleury. *Revue de Métallurgie,* Vol. 28, Nov. 1931, pages 610-616.

The final factor of safety of a cast light metal article is an integer of numberless factors both known and unknown entering their manufacturing processes. Some probable causes of defects are mentioned, among them the influence of the remelting of scrap with virgin metal. JDG (20)

Cooling Phenomena in a Steel Block. Tetsu-o Horie. *Tetsu to Hagane,* Vol. 17, Nov. 1931, pages 1104-1125.

A steel containing 0.93% C was finished into a cylindrical block, 416 mm. diameter and 650 mm. long. Thermo-couples were inserted into five holes, 9 mm. diameter, drilled into different depths from the surface to the center of the specimen. At first, the specimen was annealed at 830° C. at which Fe_3C dissolved completely in the austenite, and then 6 cooling curves including that of a point of surface were recorded during cooling of the specimen in the air. From the results thus obtained, it was revealed that the supercooling of Ar_1 transformation was remarkable at the center as well as the surface. This phenomenon is attributed to the fact that the central part is cooled slowly at high temperature by the transformation heat of the outside, but is rapidly cooled through the critical range, because the outside is already cooled to a considerably low temperature at that time. From the cooling curves obtained, cooling rate-temperature curves, cooling rate-time curves, isothermal curves, temperature distribution curves in the steel block, and temperature-cooling rate curves in critical range are drawn. When the specimen was allowed to cool in the air from 690° C., below the A_1 point, the temperature was uniformly lowered from the surface to the center. By cooling it in iron molds, 60 mm. by 30 mm., from 870° C. and 830° C. respectively, it clearly shows that the transformation heat of the outside has almost no effect on the cooling rate of the central part. From these results the author further considered theoretically on steel ingot cooled from the melt and discussed the occurrence of segregation. TS (20)

The Tensions in Undivided Cast-Iron Pulleys in Operation. (Ueber die Betriebsspannungen in ungeteilten gusseisernen Riemenscheiben.) Viktro Heuse. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Dec. 12, 1931, page 1511-1513.

Based on experiments the tensions occurring in the rim of cast-iron pulleys are analytically treated; it is found that the forces exerted by the pulling agent produce bending stresses in the whole circumference of the pulley rim. The pulley arms are subjected to longitudinal and bending stresses, the arms of the not-loaded part showing in general the same stresses as the arm on the loaded part. It is of greatest importance that the rim is uniformly thick and it is recommended to machine also the inner side of the rim as much as the arms permit. Ha (20)

The Work of the Institute of British Foundrymen in 1931. Andrew Harley. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 38-39, 42.

The author refers to the work of the I.B.F. during 1931, to the fact that three new sections of this organization have been formed during the year and to the importance the Association places upon its educational activities. OWE (20)

Recovery of Metals from Waste Materials. J. W. Hinchley. *Chemical Age,* London, Vol. 23, Dec. 6, 1930, Metallurgical Section, pages 31-32.

A condensation of a paper before the Conference of the Institution of Chemical Engineers on "The Utilization of Trade Wastes." The recovery of iron and steel, copper alloys, bronzes and tin is discussed. See also *Metals & Alloys,* Vol. 3, Feb. 1932, page MA49. VVK (20)

FOUNDRY PRACTICE & APPLIANCES (22)

Loss and Gain in Components when Melting Steel Scrap in the Cupola. E. Piwowarsky, H. Langebeck & H. Nipper. *Canadian Foundryman,* Vol. 22, Sept. 1931, pages 16-17.

Extended abstract of paper which appeared in *Die Giesserei.* See "Conditions of Absorption and Oxidation in Small Cupola Furnaces," *Metals & Alloys,* Vol. 2, Nov. 1931, page 279. OWE (22)

Binding Materials in the Preparation of Core Sands. (Des Agglomérants dans la Préparation des Sables pour Noyaux.) *Revue de Fonderie Moderne,* Vol. 25, Dec. 25, 1931, page 464.

A binding material "colsable" which is supposed to replace others, as linseed oil, molasses, dextrine, etc., is described and ratios of mixture with molding sand given for several purposes. Ha (22)

Testing Electrical Equipment in Foundries. *Foundry Trade Journal,* Vol. 45, Dec. 10, 1931, page 369.

Short article on methods that can be adopted for the testing of electrical equipment in foundries. Special attention is paid to the testing of motors for leakage, and means for making load tests on motors are described. OWE (22)

A Method for Molding a Rope Pulley. Arthur Greenhalgh. *Canadian Foundryman,* Vol. 22, Aug. 1931, pages 17, 22.

Article on the above subject, abstracted elsewhere in this journal. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 319. OWE (22)

Low Carbon Cast Iron from the Cupola (La fonte a basse teneur en carbone au cubilot). M. Kagan. *Revue de Fonderie Moderne,* Vol. 25, Nov. 10, 1931, pages 397-398.

See "Some Remarks on the Foundry Defect Called Dark Spots," *Metals & Alloys,* Vol. 2, Oct. 1931, page 228. Ha (22)

Difficulties in Modern Jobbing Foundry Practice. Kenneth S. Jewson. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, page 35.

The author emphasizes the value of rationalized melting practice and the need for recognition of variables which are likely to arise in jobbing work. Some attention is given to prices and costs. OWE (22)

Progress in Foundry Practice in the Second Half-Year of 1930 (Fortschritte im Giessereiwesen im zweiten Halbjahr 1930). H. Jungbluth & P. A. Heller. *Stahl und Eisen,* Vol. 51, Nov. 5, 1931, pages 1373-1377; Nov. 12, 1931, pages 1404-1407.

The paper reviews 114 articles on foundry practice which have been published all over the world from July to December 1930. The reviewers subdivided the material as follows: (1) structure and properties of cast iron, (2) melting practice, (3) molding and cleaning, (4) general. GN (22)

Tenth Annual Report. *British Cast-Iron Research Association,* Oct. 1931, 16 pages.

The report for the year 1930-1931 contains brief reviews of work carried out in the laboratories of the Association on molding sands and refractories, heat resisting cast-iron, particularly Silal and Nicrosilal, ingot mold iron, cupola melting practice, malleable cast-iron, alloy cast-iron, structure of cast-iron, strength of cast-iron in relation to size and foundry pig iron. Ha (22)

The "Roman Joint" in the Art Foundry. (Le Joint Romain en Fonderie d'Art.) Wisterzee. *Revue de la Fonderie Moderne,* Vol. 25, Dec. 10, 1931, page 452.

A method of joining the parts of large monuments if they can not be cast in one piece is described in order to make the joints invisible. This method was used by the old Romans. Ha (22)

The Effect of Heat on the Permeability of Coal-Dust Facing Sands and Core-Sand Mixtures. Walter M. Saunders & Walter M. Saunders, Jr. *Foundry Trade Journal,* Vol. 45, Nov. 12, 1931, pages 297, 307.

A paper, accompanied by 3 figures and 3 tables, presented and discussed at the 1931 Convention of the American Foundrymen's Association. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. OWE (22)

Meeting the Demand for Aluminum Castings. *Canadian Foundryman,* Vol. 22, Aug. 1931, pages 7-11.

An article, accompanied by 4 photographs and 1 table, in which the characteristics and applications of various sand-cast aluminum alloys are dealt with. Attention is directed to the problems of pattern and core design, of molding sand, and of gating. Melting and the effect of variations in composition resulting from the melting process are discussed, as also are "modification" and heat treatment. The value of inspection and the place which X-ray apparatus finds in aluminum foundry work are also dealt with. OWE (22)

Molds and Cores of Pure Quartz. (Formen und Kerne aus reinem Quarz.) *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 13, 1931, pages 883-884.

Molds made of pure quartz which has been melted in the electric furnace at very high temperatures are of extreme advantage as the quartz is, at all temperatures occurring in the foundry, indestructible and has a practically negligible expansion coefficient. Ha (22)

To Remove Sand from Deep-Cored Pockets. *Canadian Foundryman,* Vol. 22, Oct. 1931, page 19.

A description of the method for removing sand from deep-cored pockets in castings, which has been recommended by the Steel Founders Society of America. OWE (22)

Lead-Base Metal Versus High-Silicon Iron. *Foundry Trade Journal,* Vol. 45, Oct. 8, 1931, page 223.

A description of experience in producing lead-base containers in the iron foundry. Definite information regarding the alloy used is, however, missing from the article. The article is accompanied by one figure. OWE (22)

The Lighting of Foundries. *Foundry Trade Journal,* Vol. 45, Nov. 12, 1931, pages 298, 310.

The article deals with suitable wiring systems for use in foundries. OWE (22)

Synchronous Motor Drives in the Foundry. *Foundry Trade Journal,* Vol. 45, Nov. 26, 1931, page 330.

Advantages of synchronous motors for operating foundry plant are power factor correction, higher efficiencies, and constant speed, irrespective of load conditions. OWE (22)

What Oxidized Scrap can do to Iron. Garnet Phillips. *Foundry,* Vol. 59, Dec. 15, 1931, pages 33-34.

Unusual chilling phenomena were observed by using scrap gray iron that had been oxidized. Data obtained from tests indicate the danger in using large quantities of oxidized scrap in mixtures intended to produce gray iron of any quality. It is suggested that the amount of dissolved iron oxide in the remelted iron is the controlling factor causing the white instead of the gray fracture. VSP (22)

The Testing of Grain Size of Molding Sand. (Die Prüfung der Korngrössen von Formsanden.) G. Suliotti & E. Capello. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 13, 1931, page 883.

The grain size is determined by sieving, floating and washing; from each of these methods, curves are plotted for practical use. Ha (22)

The Standardization of the Foundry Raw Materials. (Die Normung der Giessereirohstoffe.) V. Prever. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Dec. 4, 1931, page 922.

A far-reaching standardization in the following groups is advocated: 1. Raw materials for operation of cupola furnaces. 2. Raw materials for making of cores. 3. Materials for making the mold. Ha (22)

Improvement of Foundry Products and Reduction of their Prices. (Die Verbesserung der Giessereierzeugnisse und die Herabsetzung ihrer Preise.) E. Ronceray. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Dec. 4, 1931, page 922.

Means for improvement of the product and production methods are discussed. Ha (22)

Anomalies in Hardening of Cast Iron (Anomalien beim Härten von Gusseisen). A. Le Thomas. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 6, 1931, page 867.

It has been found that, by adding to the charge a constituent containing about 2-3% Mn, the disagreeable irregularities often occurring in the hardness of castings will be prevented. This method has been found satisfactory in several foundries. Ha (22)

Where are the Young Foundrymen? S. Wells Utley. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 2, Jan. 1931, pages 761-766.

Training is urged which will produce good mechanics, skilled molders, coremakers and furnace operators, as the author believes that there are many boys who will undertake such apprentice courses if they are approached in the proper manner and are shown an opportunity in keeping with modern conditions. CHL (22)

Moulding a Water-Seal Gas-Valve Pan. Robt. Jones. *Foundry Trade Journal,* Vol. 45, Dec. 3, 1931, page 352.

An article accompanied by 9 diagrams showing the method adopted in producing a cast-iron pan with a minimum of pattern making and struck up in the foundry floor. OWE (22)

Some Observations on Synthetic Sand—Its Preparation and Use. L. B. Knight. *Canadian Foundryman,* Vol. 22, Dec. 1931, pages 11-13.

Paper presented before the American Foundrymen's Association. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. OWE (22)

Recent Progress in High Strength Gray Iron (Les fontes a haute résistance, progres récents). R. Lemoine. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 801-809. 5 references.

Very general discussion of pearlitic iron. A resume containing no new data. See also *Metals & Alloys,* Vol. 2, Oct. 1931, page 228. HWG (22)

Operating an Iron Foundry without Pig Iron. Walter Lister. *Foundry Trade Journal,* Vol. 45, Nov. 12, 1931, page 305.

The author describes how, by using an electric furnace and working it on the continuous melting principle, any quantity of iron can be poured at any time during the day and the same floor space and melting equipment used any number of times daily. A description of the best method of working follows and a table quoted gives details of the comparative costs per ton of electrically- and cupola-melted iron. Another table gives details of tests of the two types of iron. A brief editorial criticism refers to the difficulties which are frequently encountered when melting low-carbon cast iron. OWE (22)

Recent Developments in Railway Foundry Practice. T. Henry Turner. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 27-29.

An article, accompanied by 3 photographs, in which a description is given of recent developments in cast steel frames in the United States. Reference is made to the production of the Davis wheel, which has increased somewhat during the year, and to the recent introduction of steel sleepers on the Great Western Railway Company's lines. Special attention is directed to recent developments in the production of locomotive cylinders. A gradual reduction in the number of non-ferrous alloys has been made as a result of the amalgamation of certain railway companies. OWE (22)

Mold-Handling Methods. Wm. L. Hartley. *Iron Age,* Vol. 128, July 16, 1931, pages 172-173, 207-209.

Handling of molds represents between 20 and 40% of all the material handling effort in connection with foundry production. The author discusses and describes methods for the mechanization of this phase of work and layout and arrangement of equipment of the whole plant to achieve a minimum of handling. Ha (22)

Recent Developments in Aluminum Founding. D. Hanson. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 31-32.

The author discusses the troubles which have been found to occur in Al castings due to the formation of pinholes. Experiments have been conducted with a view of showing the effects of hydrogen and water vapour upon the density of virgin Al and various alloys. The desirability of controlling furnace atmospheres is pointed out. Storage conditions may affect the melting characteristics of ingots. Methods which may be adopted to prevent troubles due to pinholes and blowholes and difficulties which arise from the use of gas-free metal are also considered. OWE (22)

The Ellipsoid Furnace. Rotary Oil-Fired Furnace Features Deep Bath. *Foundry Trade Journal,* Vol. 45, Nov. 19, 1931, page 315.

A description, accompanied by 2 photographs, of an oil-fired furnace which has the appearance of a foreshortened furnace of the rotary type, the cylinder being supported circumferentially on two rollers and being permanently tilted so that the metal bath lies in the angle formed by the circumference and the base of the cylinder. The charging door is situated in the top of the cylinder. The furnace is tapped by rotating the cylinder so that the tap hole, which normally is at the top of the furnace, is brought to the side. The furnace is designed to take a 1,000-lb. charge and has been successfully used in melting cast iron, the time taken for a charge of this size being 1 hr., 40 min. OWE (22)

Plaster Patterns. *Foundry Trade Journal,* Vol. 45, Nov. 5, 1931, page 286.

A discussion of the advantages and disadvantages of plaster patterns. Provisions for drawing the pattern and the physical characteristics of the pattern material are described. 1 figure. OWE (22)

Critical Remarks Concerning the Testing of Molding Sand. (Kritische Betrachtungen zur Formsandprüfung.) Max Paschke & Eugen Schneider. *Die Giesserei,* Vol. 18, Dec. 25, 1931, pages 945-948.

The various factors which have to be taken into account in making samples for comparative tests of molding sands are discussed; such factors are mainly grain size, grain shape, colloid content, humidity, densification degree and chemical composition. It is shown that 3 ways are possible: tests can be made by the same height of the compressed samples, or by the same volumetric weight, or by the same power of compression. The possible errors in the compression of a sample in a test tube are explained. The factors determining the compressibility of a molding sand are briefly discussed; the method of calculating the compression energy is explained. Ha (22)

Aluminum Die Cast Molds (Aluminiumspritzgussformen). *Das Werkzeug (supplement to the Maschinenkonstrukteur-Betriebstechnik),* Vol. 7, June 25, 1931, pages 139-140.

The making of a die cast mold for motor hoods is described. MAB (22)

Recent Developments and Business Conditions in the U. S. A. Foundry Industry. Oliver Smalley. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 25-26.

The author introduces his subject with a concise description of business conditions in the U. S. A. and the plight of mass production foundries. Attention is then directed to technical developments of the past year and in particular to the Meehanite process. New Meehanite cupola irons include acid-resisting, abrasion-resisting, and oil-hardening mixtures. Some attention is devoted to improvements in the reclamation of core sand and to steel casting production. Malleable iron processes are also discussed, particularly the short-cycle anneal which has recently been developed. OWE (22)

Metallurgical Contributions to the Knowledge of the Phenomena in Cupola Furnaces (Metallurgische Beiträge zur Kenntnis der Kupolofenvorgänge). B. Osann, Jr. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Oct. 16, 1931, pages 809-818; Nov. 6, 1931, pages 859-866.

Exhaustive investigations of the operation of a cupola furnace are described. They were made to discover certain laws to which the metallurgical phenomena are subjected. The time of melting is considered particularly. It is measured by the temperature of the decending pig iron. It is stated that the coke charge influences the melting time considerably, irrespective of the conditions of the furnace and the other charges, because a high coke charge results in a high coke column above which the descending iron melts. The C content is always reduced to about the eutectic content when melting super-eutectic iron, but the course of melting has a certain influence. For very short melting times in the cupola furnace, the dissolving of the graphite is rather difficult but the oxidation of the graphite is enhanced during melting by the cupola furnace gases. The cast iron contains, therefore, little C. With increasing melting time, the conditions for the solution of the graphite become more favorable, so that the C content increases with the melting time. The completeness of the solution of the graphite increases with the melting time. For medium and long melting times, the C in the iron and the iron itself, are more able to react. This greater reacting ability results in stronger reactions between iron and slag and slag-forming constituents which changes the iron "secondarily." The secondarily changed iron differs from the unchanged iron melted in short melting times by lower contents of C and Mn, higher content of Si and S and finer structure. Finally, tests with small cupola furnaces are described which demonstrate the different behavior of gray and white iron at very short melting times. The process in an electric crucible furnace is also investigated. The principal result of the whole investigation is that the melting time in the operation of a cupola furnace must conform to the properties of the iron charge. Ha (22)

The Fundamentals of Brass Foundry Practice. R. R. Clarke. *Metal Industry,* London, Vol. 39, Aug. 21, 1931, pages 175-176.

Foundry practice for making Ni additions to brasses, for Monel metal, Ni-Ag, and 50-50 Cu-Ni alloys is given. PRK (22)

Coreprints. F. C. Edwards. *Foundry Trade Journal,* Vol. 45, Nov. 19, 1931, 313-314.

An article, accompanied by 12 diagrams, in which coreprint, design, and correct disposition of coreprints in molds of different designs are dealt with. OWE (22)

Molding a Blowing-Engine Piston in Loam. Hans Eckart. *Foundry Trade Journal,* Vol. 45, Dec. 10, 1931, pages 359-360.

Translation of an article on the above subject, which appeared in *Die Giesserei.* The article is accompanied by 16 diagrams which show very clearly the various processes involved in the production of this particular piston. OWE (22)

FURNACES & FUELS (23)

High-Frequency Induction Furnace Affords Heat Uniformity. H. C. Bigge. *Steel*, Vol. 88, May 7, 1931, pages 39-41, 57.

The progress in high frequency furnaces is described and the advantages in its uses for obtaining pure materials or materials of definite composition are pointed out. The construction and lining of furnaces and the compositions of products are described. Ha (23)

Industrial Furnaces for Gas. XI. Accessory Equipment. L. E. Biemiller. *American Gas Journal*, Vol. 135, Dec. 1931, pages 33-35.

Burner types and characteristics are classified. Theoretical considerations of systems of combustion are given along with a discussion of valve systems. Gas and air compressors, their characteristics and types are also discussed.

New Electric Furnaces. *Electrician*, Vol. 107, July 10, 1931, page 75.

A conveyor type equipment for the heat treatment of light metal disks is described and illustrated. The conveyor consists of 2 continuous bands of nichrome ribbon on which the metal disks are placed. Each strip or ribbon passes over grooved drums at either end. At the feed end both pulleys have independent counterweights so arranged that when the strip is hot and expands the slack is automatically taken up, keeping the strips always in tension. At the exit end of the furnace the 2 pulleys are driven by a ¼ hp. motor by means of chain and sprockets mounted on the pulley shaft of a variable speed gear permitting a rate of travel of conveyor and work adjustable between 12 to 20 in./min. The strip on its return passes under the furnace. Temperature is automatically controlled. WHB (23)

Annealing of Aluminum. *Electrician*, Vol. 106, May 8, 1931, page 690.

A large single track multi-car type electric annealing furnace with an effective hearth area 24 ft. × 7.5 ft. has been installed at the Dolgarrog Works of the Aluminum Corporation, Ltd. WHB (23)

Approximate Calculation of the Losses in the Cast Steel Ring of Soederberg-Electrodes. (Angenäherte Berechnung der Verluste im Stahlgussring bei Soederberg-Elektroden.) W. R. Blumer. *Elektrotechnische Zeitschrift*, Vol. 52, Dec. 24, 1931, page 1580.

The eddy current losses in a water-cooled steel ring electrode of an electric furnace for 70,000 amp. were calculated as 55 KW. To reduce this it is proposed to put a protective Cu layer on the ring. Ha (23)

Notes on Gas Producer Practice at Frodingham, together with General Observations. L. Cook. *Iron & Steel Industry*, Vol. 5, Oct. 1931, pages 23-26.

Abridged copy of a paper read at the Nov. 1931, meeting of the Lincolnshire Iron & Steel Institute. Steam jets have been replaced by centrifugal blowers in gas producers. The necessity for keeping the fires in good condition by balancing poor coal against good coal is stressed. The calculation of producer efficiency is discussed. CHL (23)

Prevention of Smoke in Metallurgical Operations. C. H. Desch. *Canadian Chemistry & Metallurgy*, Vol. 16, Jan. 1932, pages 17-18.

The ultimate solution of the smoke problem lies in electrical heating for steel and non-ferrous alloy industries. See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 49. WHB (23)

Italian Electrodes Made of Natural Graphite. Correspondence from F. Giolitti, Turin, Italy. *Metal Progress*, Vol. 21, Feb. 1932, pages 64-65.

The writer describes the solution of the problems of high electrical conductivity and slow combustibility in graphite electrodes. WLC (23)

Water-Cooled Furnaces and Firing Methods for Pulverized, Liquid and Gaseous Fuels. G. W. Glendon & Otto de Lorenzi (Combustion Engineering Corp.). *Combustion*, Vol. 3, Feb. 1932, pages 23-29.

Application of water-cooled furnace linings to replace those of refractory material has been one of the principal reasons for the success of modern high capacity steam generating units. Improvements in furnace design and construction as well as in methods of firing have been extraordinarily rapid. Various methods of firing are discussed, particularly corner firing, in which, burners are placed in 4 corners of the furnace and complete water-cooling is necessary. All 4 walls are covered with straight bare tubes with a minimum amount of refractory. DTR (23)

Development of the Calorific Power Determination of Solid Fuels. (Zur Entwicklung der Heizwertbestimmung fester Brennstoffe.) K. d'Huart. *Die Wärme*, Vol. 53, Apr. 26, 1930, pages 313-317.

Calorimetric determination and calculation of calorific power of solid fuels in Germany. Relationship between the combustion heat and the amount of air required for combustion. Critical review of French publications. EF (23)

Insulating Open-Hearth Furnaces. S. M. Jenkins. *Steel*, Vol. 88, Apr. 16, 1931, pages 35-38, 48.

The grade of insulating brick to use in open-hearth furnaces, how it should be installed, cost of insulating furnace equipment and the returns on the investment are described and discussed. Ha (23)

Measurement of Heat Value of Solid Fuels. (Heizwertmessung bei festen Brennstoffen.) Jos. Kroenert. *Archiv für Technisches Messen*, section V9214-1, 1931, page T14.

The heat value of solid fuels is calculated either indirectly from the chemical analysis or is determined directly in a calorimeter. The methods are described and the procedures explained. Ha (23)

Approximation Method for Calculating the Heat Exchange in Regenerators. (Näherungsverfahren zur Berechnung des Wärmeaustausches in Regeneratoren.) H. Hausen. *Zeitschrift für angewandte Mathematik und Mechanik*, Vol. 11, Apr. 1931, pages 105-114.

Graphical and numerical approximation methods are developed for the calculation of the time/temperature course in regenerators and the combined utilization of both methods is urged. EF (23)

Changing Trend of Power Distribution in the Steel Plant. S. S. Wales. *Proceedings Engineers' Society of Western Pennsylvania*, Vol. 47, Oct. 1931, pages 385-390.

The development of steam from by-product furnace gas (blast furnace, open-hearth, Bessemer, etc.) and the generation of electricity therefrom are discussed. For metallurgical purposes it is not as essential to clean the by-product gas as it is in the generation of power. By-product gas has a higher load-factor when used in the open hearth than in the power plant. This new trend of selling blast furnace gas to the public, and the steel plant buying its electricity is being developed more in Canada and Europe than in this country. Higher temperatures may be obtained from by-product coke gas than from blast furnace gas. WAT (23)

Measurements of the Rate of Flow of Liquid Metals in the Electric Furnace (Messungen der Strömungsgeschwindigkeit flüssigen Metalls im Elektroofen). M. Riepe & H. Ilberg. *Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 2, Nov. 1931, pages 413-417.

The article considers the general and theoretical phases of the rate of flow of liquid metals in the electric furnace; describes the set-up and the basis for tests; gives the measurements obtained; and concludes that in an electric furnace the power used and the kind of current are of prime importance. The measurements were made by means of a throttle tube. The character of the current in the conduits of an electric furnace is determined by the existence of the electrodynamic power. The basis for calculating the amounts of metal put into circulation was determined with reference to the total friction of the liquids. The average velocity in the cross sectional area of a melt conduit diminished linearly with the distance of the area from the opening of the conduit at the bath. MAB (23)

Modern Constructions of Sheet Annealing Furnaces (Neuzeitliche Bauarten von Feinblechglühöfen). L. Pletsch. *Stahl und Eisen*, Vol. 51, Nov. 26, 1931, pages 1481-1483.

Some new constructions of German and English box annealing and continuous annealing furnaces are described. One furnace has bottom heating and a capacity of 80-92 tons of sheets with the boxes being moved on balls. Another furnace has an output of 110 tons of sheets. In the 2 English furnaces shown in sketches and used for normalizing automobile sheets and sheets for deep drawing purposes, the sheets are moved by arms without injuring the material. The arms subjected to high temperatures are made of heat resisting steel. GN (23)

Coreless Induction Furnace Larger; Lining Improved. E. F. Northrup. *Steel*, Vol. 88, June 4, 1931, pages 39-42.

The principles of the coreless induction furnace are explained and some new developments in its construction are described. Its uses for making high-grade and high-melting steels are discussed. Ha (23)

Anthracite Gas Reduces Scale Loss in Wire Processing. H. R. Simonds. *Steel*, Vol. 89, Sept. 17, 1931, pages 31-33.

Producer gas generated from anthracite is being used throughout the wire processing departments of the Stewart Hartshorn Co., Newark, N. J.; the equipment is described.

Temperature Distribution in Industrial Furnaces. Wirt S. Scott. *Electric Journal*, Vol. 28, Dec. 1931, pages 668-672.

A comprehensive investigation of electric and fuel furnaces showed wide variations between temperatures as recorded on control charts and those actually existing inside the furnaces in operation under normal conditions. The furnaces investigated were all in first class condition, but varying in age from 3 mo. to 10 yrs. An electric furnace can be made to operate with machine-like precision with close temperature control, whereas gas-fired furnaces are not evenly heated. WHB (23)

Modern Furnaces. Richard Rimbach. *Metals & Alloys*, Vol. 2, Sept. 1931, pages 158-164.

The author describes installations of heat treating and metallurgical furnaces to show the advances that have been made in operating efficiency, application of fuels, and quality of product by improved furnaces. WLC (23)

The Present State of the Electric Melting Furnace (Lo stato attuale dei forni elettrici fusori). O. Scarpa. *La Metallurgia Italiana*, Vol. 23, Oct. 1931, pages 909-941, 26 figures.

A general discussion of electric furnaces for non-ferrous melting, including various obsolete types is given. Furnaces for ferro alloys are also briefly discussed. HWG (23)

Experiments on the Occurrences of Combustion in a Flame of Pulverized Coal. (Versuche über die Verbrennungsvorgänge in einer Kohlenstaubflamme.) H. Schwiedessen. *Archiv für Eisenhüttenwesen*, Vol. 5, Dec. 1931, pages 291-298.

Report 157 of the Committee on Heat of the Verein deutscher Eisenhüttenleute. 4 references. Experiments were carried out in a pusher-type rolling mill furnace heated with pulverized coal. Temperature, gas content and fuel loss depend purely on the time of burning. In using only primary combustion air a true zone of degasification does not exist. The expulsion of volatile matter from the pulverized coal is extended through a rather long part of the combustion chamber since the volatilization is retarded by the external slagging of the grains of coal. However, the volatile matter burns immediately upon being expelled from the coal. The velocity of combustion is strongly affected by the concentration of O and the above-mentioned slagging. GN (23)

A Modern Foundry Core-Oven. (Un impianto moderno per la cottura delle anime in fonderia.) E. F. Russ. *La Metallurgia Italiana*, Vol. 24, Jan. 1932, pages 27-28.

An electric core oven 16 meters high has a conveyor system by which the cores are carried upward through the baking zone. The vertical arrangement of the oven saves floor space and avoids heating the core-room. HWG (23)

Soaking Pits without Checkers. J. B. Nealey. *Blast Furnace & Steel Plant*, Vol. 19, Nov. 1930, pages 1707-1708; *Steel*, Vol. 89, Aug. 27, 1931, pages 31-32.

A new type of soaking pit is described. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 24. Ha (23)

Outdoor Annealing Furnace 60 ft. long, 14 ft. wide. *Steel*, Vol. 89, Dec. 28, 1931, page 27.

A furnace used for relieving strain in large fusion welded pressure vessels and some constructional details are described. Ha (23)

One-Ton High-Frequency Induction Furnace. *Iron & Coal Trades Review*, Vol. 123, Dec. 11, 1931, page 908.

The furnace is operated by 500 cycle, 2000 volts, and has a capacity of 600 kw. The full charge of 1 ton can be melted in 1 hour. Curves of cost at different loads are given. Ha (23)

The Rotary Furnace "S.E.S.C.I." (Der Drehofen "S.E.S.C.I.") *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, pages 867-868.

A furnace consisting of an Fe sheet cylinder with truncated cones at the ends, lined completely with a refractory, tamped material, and heated by pulverized coal is made for continuous, uninterrupted operation in the manufacture of cast Fe and all kinds of steel. The economy is equal to or even better than that of the cupola furnace. Loss of metal is less than 1%. The lining will stand a temperature of 1800° C. The combustion air is preheated to 600° C. A melt (from cold furnace) for malleable Fe takes 3¼ hrs. and the third, 2 hrs., with less than 20 mins. between melts. 14 installations are already in operation in France, Italy, Belgium and England. Ha (23)

Gas versus Electricity in the Metallurgical Industry (Gas oder Elektrowärme in der metallverarbeitenden Industrie). D. I. Aigner. *Gas und Wasserfach*, Vol. 74, Aug. 29, 1931, pages 814-816.

The advantages and disadvantages of generating heat for metallurgical purposes from gas and from electricity are considered from a technical and economical stand-point. The author is, apparently, in favor of heating metallurgical furnaces by gas and carries out a detailed economical calculation in the case of a bath for hardening drills. The superiority of electric heating claimed for a set of 8 annealing furnaces (total output 30 tons/day) is critically discussed and passing mention is made of furnaces for melting Zn, Sn, Al, and Cu-alloys for the enamelling process. EF (23)

Appearance of Oil in Blast Furnace Gas Lines. (Auftreten von Oel in Hochofengas-Leitungen). Herbert A. Bahr & Vitus Jessen. (Völklingen, Saar). *Stahl und Eisen*, Vol. 52, Jan. 7, 1932, pages 13-15.

Blast furnace gas from the Völklingen blast furnaces contained a mist of oil. A part of the charge was rolling mill scale carrying 0.13% oil. The distillation temperature, specific gravity and solubility of the oil in the blast furnace gas were similar to those of the oil in the mill scale. The oil in the gas was absorbed by a fine dust filter and there was a possibility that oil had passed from the dry gas purification system directly into the pure gas lines. The possibility for formation of oil in the blast furnace by the Fischer-Tropsch synthesis was discussed and a certain probability was seen for this condition from the CH_4 formation in the furnace. GN+DTR (23)

The Distribution of the Electrical Field in the Arcs of Electric Furnaces with Interrupted Operation for the Melting of Steel. (Ueber die Verteilung des elektrischen Feldes in den Lichtbögen elektrischer Oefen mit unterbrochenem Betrieb zur Erschmelzung von Stahl.) G. Agostinelli. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Dec. 4, 1931, page 923.

A method is described for determining from the physical properties of the electric arc the distribution of the potential and of the electric field in all positions of the electrodes by means of an elliptical coördinate system. The influence of the magnetic field in a furnace with 3 electrodes was investigated with an oscillograph. Ha (23)

The Slag-Tap Furnace for Burning Pulverized Coal. E. G. Bailey & R. M. Hardgrove. *Rolling Mill Journal*, Vol. 5, Dec. 1931, pages 787-790.

The great importance of the ash content of a fuel and the fusing temperature of the ash, whether higher or lower than the furnace temperature, and the attending difficulties in the latter case, are thoroughly discussed. The different systems of ash removal from the furnace are described. The advantages of the slag-tap furnace are mainly complete combustion of the coal, smaller building height; and simple removal of ash by letting it flow into a sluice. This type of furnace can be used successfully with all coals where the ash has a fusing temperature below 2500° F. Low grade coals can be burnt with better efficiency. Ha (23)

The Oil-Cupola, System Marx. (Der Öl-Kupolofen, System Marx) E. Becker. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 53, Jan. 17, 1932, pages 29-30.

A new cupola with oil heating is described and compared with the Wüst furnace. It offers the following metallurgical advantages: The S content of the melt can be kept very low, since the oil used contains little S, the melt can be easily superheated, thus securing a fine grained structure; the flame can be properly regulated and the waste of metal through oxidation is small. The cupola is fit for the production of high test cast Fe. The oil consumption is about 6.5% (by weight) of the charge; the heat efficiency amounts to about 43% which is by about 80% better than that of the coke-fired cupola. GN (23)

Recent Developments in British Blast Furnace Coke Technology. Edgar C. Evans. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 83-86.

The work done by research committees in determining standards by which coke may be evaluated is discussed. Shatter tests and measures of reactivity have been suggested and general recommendations made governing the manufacture of coke. CHL (23)

Air-Gas Proportioners Serve Bolt and Rivet Furnaces. F. J. Evans. *Steel*, Vol. 89, Sept. 10, 1931, pages 46-50.

An installation of air-gas proportioners in a bolt and rivet factory is described. Ha (23)

The Selection of Coke for Foundry Purposes. (Koksauswahl für Giessereizwecke.) Otto Huppert. *Giesserei Zeitung*, Vol. 27, Jan. 15, 1930, pages 35-37.

Coke with low H_2O, ash and S content and high strength are desirable. For cupola coke, low activity (velocity of reducing CO_2 to CO) is debatable. This activity is attributed to the unsaturated amorphous C atoms. When activity is desired the graphitization caused by coking at too high a temperature is to be avoided. (23)

REFRACTORIES & FURNACE MATERIALS (24)

New Developments in Unburned Magnesite Brick for Metallurgical Industry. A. E. Fitzgerald (Condensed by M. F. Behar) *Metals & Alloys*, Vol. 3, Jan. 1932, page 25.

The use of higher pressure, proper size mixtures and a colloid bond have produced an unburned magnesite brick of satisfactory strength without excessive shrinkage under service conditions. Properties and applications are discussed. WLC (24)

Properties of Silica Brick Manufactured from Sharon Conglomerate. C. L. Frederick, Jr. *Journal American Ceramic Society*, Vol. 15, Jan. 1932, pages 61-67.

New developments in the field of silicate refractories include greatly improved refractoriness and a high development of desirable qualities in silica refractories manufactured from Sharon conglomerate. The nature of silica refractories in general is discussed and a résumé of materials utilized in the manufacture of silica brick in the United States is given. Several illustrations of this new refractory are included, as well as test data. WAT (24)

The Alumino-Silicate Refractories. G. A. Bole (Ohio State University). *Metals & Alloys*, Vol. 3, Jan. 1932, pages 15-22.

The author's discussion of alumino-silicate refractories is prefaced with a consideration of the equilibrium diagrams of SiO_2-Al_2O_3 and SiO_2-Al_2O_3-CaO. The simpler the phase structure of a refractory the greater resistance to heat, providing of course that the individual phases are themselves resistant. Increase in the number of phases increases the tendency to form eutectics of low melting point. Mullite is the only aluminum silicate stable at high temperatures, $3Al_2O_3 \cdot 2SiO_2$. All aluminum silicate minerals invert to mullite on heating and sweat out a highly siliceous material at 1545° C. Sillimanite, andalusite and cyanite are minerals all of composition $Al_2O_3SiO_2$ and invert to mullite on heating and sweat at 1545° C. Minerals of higher Al_2O_3 than 56% melt at 1810° C. to liquid and corundum. The changes in firing various alumino-silicate minerals, sillimanite, diaspore, and kaolin are described and discussed. The properties of various commercial grades of mullite, sillimanite, andalusite, kaolin, and diaspore refractories are described and their applications discussed. WLC (24)

Refractories for Blast Furnaces and Hot Blast Stoves. W. G. Girling. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 95-96.

The author discusses the trend toward machine-made brick and presents the results of observations of foundrymen on the best chemical analysis for brick in the sections of the blast furnace. A typical analysis for machine-made brick is given as follows, silica 55.30, alumina 37.09, ferric oxide 2.29, lime 0.62, magnesia 0.83, alkali 1.98, and titanium oxide 1.72%. The refractoriness was found to be cones 31-32, 1700° C., the true specific gravity to be 2.52%, and the cold crushing strength to be 5,846 lbs./in.^{2} CHL (24)

Effect of Firing at 1500° C. on the Porosity and Specific Gravity of Quartzites. Sanford S. Cole. *Journal American Ceramic Society*, Vol. 15, Feb. 1932, pages 87-95.

Quartzites from the various deposits being commercially utilized for the manufacture of silica brick in the United States, Canada and Europe were tested for porosity and apparent specific gravity before and after firing at 1500° C. for 2 hours. Petrographic examination was made of several of the raw quartzites, and the differences in crystalline structure are shown by photomicrographs. The rate of conversion of the quartz was not constant for the quartzites reported. The porosity after firing varied from 2 to 30% and the apparent specific gravity varied from 2.30 to 2.44. A fine-grained quartzite tends to give lower porosity after firing. WAT (24)

Bonding Magnesite Linings for Steel Melting Furnaces without Use of Iron Oxide. Louis Jordan (U. S. Bureau of Standards). *Metals & Alloys*, Vol. 3, Jan. 1932, pages 22-24.

The author describes experiments in the preparation of a basic lining in a rocking type indirect arc furnace. The use of iron oxide as a bond in furnace bottoms often results in weakening of the bottom due to solution of the bond from the magnesite by deoxidized metal in the bath. A bond of water-ground magnesite was used with electrical sintered magnesite and gave excellent results under rather severe conditions of overheating and intermittent operation. WLC (24)

Refractory Materials. Alexander H. Hayes. *World Power*, Vol. 16, Dec. 1931, pages 450-454.

The variable factors governing the choice of refractory materials, and the most important materials (silicas and fireclays, high alumina refractories, chromite, dolomite, magnesite, and silicon carbide) are dealt with in a general manner. Metallurgy has adopted, as result of experience, certain general rules for the employment of different classes of refractories. It is unfortunate, from the users standpoint, that the selection of refractory materials cannot be subjected to rigid specifications. Since a primary requirement for refractory materials is the ultimate economic value of the refractory, it is practically a necessity in every case to study the local conditions in relation to the physical and mechanical characteristics of different materials available, before the most economical refractory can be chosen. The choice inevitably resolves itself into a compromise between cost and the maximum desirable properties. WAT (24)

Progress in the Field of Refractories. Annual Report from October 1929 to September 1930 (Fortschritte auf dem Gebiete der feuerfesten Baustoffe. Jahresübersicht Oktober 1929 bis September 1930). E. H. Schulz, F. Hartmann & A. Kanz. *Stahl und Eisen*, Vol. 51, Dec. 17, 1931, pages 1569-1573; Dec. 24, 1931, pages 1595-1599.

The report reviews 109 papers on refractories dealing with (1) raw materials, preparation and processing; (2) furnaces and operation; (3) testing methods and equipment; (4) properties; (5) quality requirements and specifications; (6) special refractories and newly developed materials; (7) cement, concrete; (8) literature. GN (24)

GASES IN METALS (25)

The Occurrence of Small Quantities of Gases and Oxides in Aluminum and Aluminum Alloys. (Ueber das Auftreten kleiner Mengen von Gasen und Oxyden im Aluminium und in Aluminiumlegierungen.) R. Sterner-Rainer. *Zeitschrift für Metallkunde*, Vol. 23, Oct. 1931, pages 274-282.

Includes discussion. The work of Czochralski, and Claus on the solution of gases in molten Al alloys and the formation of oxides is discussed. The gas content of molten Al alloys is best determined by melting in a vacuum and by planiometric study of the sectioned ingot. Oxides are determined by weighing Al_2O_3 after solution in an acid. The absorption of gases and the formation of oxides cannot be wholly prevented, but can be reduced by holding the molten alloy for a period just above the melting point (710°-730°C.) and by bubbling gases through the molten metal. N_2 and Cl_2 are helpful. Dissociating chlorides (zinc chloride, silicon trichloride, chlorides of Fe, Sn, and Ti). Better results have been obtained with mixtures of various easily decomposed chlorides containing bifluorides; this mixture, containing also siliceous earth, asbestos wool, coal dust, etc., was worked into a paste and pressed down to the bottom of the metal bath. Followed by a lengthy discussion. RFM (25)

The Sorption of Hydrogen on Copper. Part 1. Adsorption and the Heat of Adsorption. Part 2. Rate of Solution. A. F. H. Ward. *Proceedings Royal Society*, Vol. 133A, Oct. 1931, pages 506-535.

The sorption and heats of adsorption of H on activated copper catalysts have been measured at 25° C. for successive additions of gas. The instantaneous adsorption on the surface was followed by solution which occurred very gradually. The difference allowed these processes to be separated and the true adsorption isotherm found. This was exactly reversible on decreasing the pressure. After correcting for gas in solution and the heat of combustion of the gas, the heats of adsorption and desorption were found to be independent of the concentration of the gas on the surface, but decreased after each baking of the copper till they reached a final value of about 9000 cal. per gram-molecule. The isotherms were not affected by baking below the temperature of preparation of the copper (150° C.), but after sintering above this temperature the amount of gas adsorbed was decreased. The effect of points of high energy on the activity of the whole surface is discussed. The adsorption of H on Cu and the rates of diffusion into the interior of the metal have been measured at various pressures over a temperature range 25°-200° C. It is shown that for any temperature the rate of diffusion into the metal is proportional to the amount of gas adsorbed on the surface. The rate of diffusion is, therefore, related to the gas pressure by the same form of equation as the adsorption isotherm. The variation of the rate of diffusion with temperature gives an energy of activation for the diffusion process of 14,100 cals./gram-molecule. The previously accepted theory that the diffusing molecules are split up into atoms, since diffusion rates are proportional to the square root of the pressure, is criticized and shown to be improbable. Calculations from figures of other workers are in agreement with the theory developed here. Reasons are given why it is probable that grain boundary diffusion is occurring rather than lattice diffusion. WAT (25)

Modern Methods for the Determination of Gases in Steel. B. Jones. *Metallurgist*, Oct. 1930, pages 151-152.

An excellent summary of 39 references on the determination of O, N and H in iron and steel. VVK (25)

Oxygen, Nitrogen, and Hydrogen as Constituents in Metals. H. C. Vacher. *Journal of Chemical Education*, Vol. 9, Jan. 1932, pages 47-54.

Many metals while in the liquid state, dissolve more O, N or H than can be retained in solution in the solid metal. This results in the formation of gas pockets or non-metallic inclusions in the solid metal. Methods are developed which permit the determination of the amounts of these elements actually dissolved in the metal and those contained in the inclusions. The effects of gas pockets and non-metallic inclusions on the mechanical properties are quite familiar. The effects of relatively small amounts of the 3 gases which may exist in solution in the apparently sound material are not yet definitely known and have been recognized only recently. The methods which permit an estimation of the amount and the manner in which O may exist in plain C steels are vacuum fusion, H reduction and residue methods. A list of selected bibliography on gases in metals is added. Ha (25)

Oxygen films on Tungsten. I. A Study of Stability by Means of Electron Emission in Presence of Caesium Vapor. I. Langmuir & D. S. Villars. *Journal American Chemical Society*, Vol. 53, Feb. 1931, pages 486-497.

A method is presented of studying the rate of loss of oxygen from an adsorbed film on tungsten, as well as of detecting its presence in a gas. This consists in observing its effect on the electron emission of a tungsten filament, sensitized by the presence of minute traces of cesium vapor. Under properly chosen conditions a monatomic oxygen film makes its presence known by increasing the emission a millionfold. MEH (25)

Determination of the Energy Levels of Adsorbed Hydrogen and Oxygen by the Method of Electron Impacts (Bestimmung der energetischen Niveaus des absorbierten Wasserstoffs und Sauerstoffs nach dem Verfahren des Elektronenstosses). N. I. Kobosew & W. L. Anochin (Moskow State University). *Zeitschrift für physikalische Chemie*, Abt. B, Vol. 13, June 1931, pages 18-62.

The rate of release of adsorbed H_2 or O_2 from metallic surfaces as a function of the potential drop through which bombarding elements have passed was used to study various characteristics of adsorbed H_2 and O_2. The measured release potentials measured on Pd, Pt, Au, Zn and Pb directly confirm the over-voltage theory of Kobozew and Nekassov. EF (25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Effect of Copper in Cast Iron. Correspondence from C. G. Williams (Barker Machine Works & Tool Co.). *Metal Progress*, Vol. 20, Nov. 1931, pages 81-82.

The writer tells of interesting experience with copper in Ni-Cr cast iron as increasing the resistance to corrosion with less Ni and Cr and giving very excellent wear-resistance. WLC (27)

Nickel in Non-Ferrous Metals (Nickel in Nichteisenmetallen). H. Kalpers. *Dinglers Polytechnisches Journal*, Vol. 345, Jan. 1930, pages 3-6.

The addition of Ni to brass, bronze and Cu-alloys is discussed at length. The chemical analyses, physical properties and commercial significance are stressed. EF (27)

Alloyed Castings. (Legierter Guss.) E. Kothny. *Giesserei-Zeitung*, Vol. 27, June 1930, pages 291-300, 323-327.

A review of the effects of Ni, Cr, Ni-Cr, Ti, Al, B, Ce, Co, Cu, W, Mo, Va and Zr upon the constitution and the physical and chemical properties of gray, chilled and malleable Fe castings. A bibliography is appended. (27)

The Effect of Manganese in Cast Iron. (Die Wirkung des Mangans im Gusseisen.) K. Lehmann. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 53, Jan. 10, 1932, pages 18-20; Jan. 17, 1932, pages 31-32.

General survey as to how Mn affects the properties of cast iron. GN (27)

The Influence of Carbon on the Structure of Austenitic Nickel-Chromium Alloys. (Der Einfluss des Kohlenstoffes auf das Gefüge der austenitischen Nickel-Chromlegierungen.) E. R. Thews. *Die Metallbörse*, Vol. 21, Jan. 3, 1931, pages 6-7; Jan. 31, 1931, pages 197-198.

The influence of C in binary Cr and Ni alloys and in 18/8 on the metallographic structure is summarized, the influence of cold work is discussed and the proper heat treatment of austenitic Cr-Ni steels is summed up. The influence of the carbon precipitations on the chemical and physical properties of 18/8 is considered. EF (27)

A Study of the Influence of Iron in Duralumin. (Eine Untersuchung über den Einfluss des Eisens in Duralumin.) W. Kroenig. *Zeitschrift für Metallkunde*, Vol. 23, Sept. 1931, pages 245-249.

5 alloys were studied of the compositions 4.58 to 4.70% Cu, 0.45 to 0.50% Mg, 0.56-0.65% Mn, 0.25-0.33% Si, with 0.22, 0.52, 0.93, 1.10, 1.50% Fe respectively. It is shown that increasing Fe diminishes the tensile strength and hardness, and that this difference between Fe-rich and Fe-poor alloys is increased by increase in quenching temperature. Duralumin with Fe has a lower tensile strength and hardness immediately after quenching than duralumin low in Fe, owing presumably to diminution in solid solubility of $CuAl_2$. The increase in strength on aging at room temperature is constant with increasing Fe-content; the hardness however increases more in an alloy with 0.22% Fe than in an alloy with 1.5% Fe. The hardness of thoroughly annealed duralumin with different Fe-contents approaches a constant value the more thorough the annealing. Up to 0.9% Fe the iron is found in the form of an eutectic; at higher Fe-compositions it occurs as primary crystals. It is shown that the $CuAl_2$ is restrained from solution by the eutectiferous Fe, thus affecting the mechancial properties of duralumin containing Fe. RFM (27)

Various Factors Affect Growth of Gray Cast Iron. W. E. Remmers. *Steel*, Vol. 88, Mar. 5, 1931, page 63.

A brief description of studies made with alloying elements; Si, Al, Ti and Ni tend to increase growth, Cr and Mn tend to decrease it. Ha (27)

Sulphur and Phosphorus in Quality Steels. Correspondence from B. F. Shepherd (Ingersoll Rand Co.). *Metal Progress*, Vol. 20, Nov. 1931, pages 78-79.

The writer gives Swedish and French ideas about these 2 elements. WLC (27)

The Effect of Small Additions of Aluminum to Gray Cast Iron (Der Einfluss kleiner Zusätze von Aluminium zu grauem Gusseisen). G. Sirovich. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, page 867.

An addition of up to 1% Al increases the fluidity and the disintegration of the cementite in favor of a better graphitization. This is advantageous for producing thin-walled castings and a better machineability. An increase of more than 1% is useless. Ha (27)

Influence of Magnesium Oxide on Reduction, Oxidation, and Carbonization Reactions of Iron. (Der Einfluss des Magnesiumoxyds auf die Reduktions-, Oxydations- und Kohlungsvorgänge beim Eisen). Josef Klärding. *Stahl und Eisen*, Vol. 52, Jan. 7, 1932, page 15.

Reactions of mixtures of Fe_2O_3 and MgO in proportions of 2:1, 1:1, and 1:10, respectively, with cementite at 650° C. and those of Fe and MgO and Al_2O_3 in varying proportions with CO at 650° C., are shown on equilibrium diagrams, as displacements from pure system Fe-C-O. With increasing magnesia and alumina, reaction goes in the direction of higher CO formation, although the writer points out that at 650° the diffusion was only slight, and the exact effect of the MgO could not be determined. GN + DTR (27)

Vanadium in Steel Castings. *Foundry Trade Journal*, Vol. 45, Dec. 10, 1931, pages 364, 368.

An article based on information supplied by High-Speed Steel Alloys, Limited, of Widnes, Lancaster, Eng. The characteristics of V steel castings are described. Following this description, the Ni-V steels, Mn-V steels and Cr-V steels are dealt with in order. The situations in which these steels are finding use are discussed, and in conclusion the relatively small cost of V steels as compared with steels free from this element is pointed out. OWE (27)

The Various Elements in Cast Iron. Gilbert S. Schaller. *Western Machinery World*, Vol. 22, Sept. 1931, pages 428-431.

Discusses briefly the effects and actions of C, Si, S, Mn and P, as well as the forms which C assumes in cast iron. WAT (27)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Apparatus for Determination of Thermal Expansion of Solid Bodies at High Temperatures. (Ueber einen Apparat zur Bestimmung der Thermischen Ausdehnung fester Körper bei hohen Temperaturen). H. Gerdien & W. Jubitz. *Zeitschrift für technische Physik,* Vol. 10, 1929, pages 614-620.

Detail sketches of a thermal expansion outfit in which water-cooled contacts are not kept touching the specimen through the run, but are periodically brought up against the specimen, and the pressure under which contact is made is measured by electrical means. The contact only lasts 1/10 sec. in making a measurement. The apparatus is very complicated and for details the original must be consulted. Calibration is by means of a silver specimen. The specimens are 200 mm. long. The expansion coefficient of Ni from 20° to 1000° C., determined with the apparatus, is 16.76×10^{-6} and that of soft iron from 20° to 720° C., 15.12×10^{-6}.

Permanent Growth of Gray Iron on Heating. (L'ingrossamento permanente della ghisa grigia per effetto del calore.) G. Calbiani. *La Metallurgia Italiana,* Vol. 23, Dec. 1931, pages 1135-1145; *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 6, 1931, page 866.

Gray iron of 3.25% total C, 1.34% Si, 0.41% Mn, 0.07% P, 0.13% S was cast into step castings, with steps 50, 30, 15 and 5 mm. high by 50 mm. (each step, 200 mm. total length) by 80 mm. and into bars of 32 and 47 mm. diameter. The step castings were not machined. The bars were machined into cylinders of various diameters. 3 sets of specimens were heated, respectively to 650°, 750° and 850° C. for 8 hrs.; the heating was repeated 10 times. Growth was measured and compared with the ratio of surface to volume of the specimen. The greater is the ratio of surface to volume, the greater the growth. The percentage increase in length on specimens with a ratio of 0.93 was: 650° C., 0.42%; 750° C., 0.65%; 850° C., 1.38%; while at the other extreme, with a ratio of 4.70, the figures were: 650° C., 1.86%; 750° C., 2.40%; 850° C., 4.54%. The complete data are tabulated and micrographs of the structure shown. Contains 35 figures, 11 references. Ha + HWG (29)

Use of Metals at High Temperatures. H. A. DeFries. *Conference on Metals & Alloys, Case School of Applied Science, Cleveland, Ohio,* Paper No. 12, Nov. 1931. Mimeographed. 7 pages.

A general resumé. Plain 0.20% C steel is usable to around 900° F.; its load for a creep rate of 1% in 100,000 hrs. is 7,800 lbs./in.² A 5% Cr steel has only 5,100 lbs./in.² at 900° F., but is more resistant to scaling. One with 12% Cr and 0.10% C can be used to 1100° F., where it gives 4,000 lbs./in.² The 18 Cr, 8 Ni alloy with 0.07% C maximum can be used to 1300° F. where it has 3,000 lbs./in.² Above that temperature brittle breaks may occur without deformation as a warning. Other compositions are briefly discussed.

The Exact Measurement of the Specific Heat of Osmium and Rhodium between 0° and 1625° C. F. M. Jaeger & E. Rosenbohm. (In English.) *Proceedings, Koninklijke Akademie van Wetenschappen te Amsterdam,* Vol. 34, No. 1, 1931, pages 85-99.

The atomic heat at constant pressure is, for Os, 5.9152 + 0.0009019t. The atomic heat at constant pressure for Rh rises from 6.064 at 0° C. to 8.354 at 1200° C. and then falls to about 7.60 at 1625° C. No corresponding anomaly was found in the thermoelectric force against Pt. There is an inflection in temperature-electrical resistance curve for Rh at 1000°-1100° C., but no sudden break. While electrolytically deposited Rh or that obtained by reduction with hydrazine sulphate contains two modifications α and β, the α disappearing above 1400° C., the shape of the specific heat-temperature curve is not accounted for by transformation of allotropic modifications. HWG (29)

A Method for the Measurement of the Temperature Coefficient of Heat Conductivity of Materials (Sur une méthode de measure du coefficient de conductibilité calorifique des matériaux). L. Joly. *Comptes Rendus,* Vol. 192, Mar. 30, 1931, pages 797-799.

A discussion of the theory underlying the measurement of heat conductivity in materials, followed by a description of methods adopted by le Comité du Génie de l'Office national des Inventions for making such determinations.

The Performance of Cast Carbon and Low-Alloy Steels in High- and Low-Temperature Service. R. A. Bull (Electric Steel Founders' Research Group). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 394-435.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 191. In the discussion it is pointed out that imperfect castings have probably been the greatest single cause of trouble in the service of cast furnace parts. The superiority of cast materials over wrought materials of the same composition for elevated temperature service is also noted. It appears that the outstanding need in creep testing at the present time is a determination of the effect of the various alloying elements upon the recrystallization range of iron. At temperatures below the recrystallization temperatures, stresses of appreciable magnitude may be withstood without continuous deformation or creep, at least within the sensitivity of the measuring apparatus, employed, while above, continuous creep is produced by any stress regardless of its magnitude. Within the recrystallization range there appears to be a direct relationship between a definite rate of creep and the proportional limit as determined in the short-time tensile test. Emphasis is placed on the significance of design in elevated temperature serviceability. There is much need of coöperation between designers and manufacturers. A review of existing data makes it appear that cast Cr-Mo, Ni-Cr-Mo, C-Mo and Mo-Mn steels give promise of being superior alloys for elevated temperature high pressure service under 1000° F. WAT (29)

Properties of Bearing Metals at Normal and Elevated Temperatures. E. R. Darby (Federal Mogul Corp.) *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 316-339.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 191. In the discussion it is pointed out that the statement made in the paper, relative to white metal alloys, namely that Pb-base alloys are generally weaker and softer at elevated temperatures than are Sn-base alloys, is not entirely supported by the experimental data included, nor is it in agreement with results of recent determinations at the U. S. Bureau of Standards. Determinations of the resistance to pounding and of the hardness of some white metal bearing alloys indicate that the Brinell hardness of the Pb-base alloys containing 5 % or more of Sn equals or exceeds that of the Sn-base alloys up to 150° C. The hardness of the Pb-base alloys, excepting an alkali-hardened Pb alloy, and of a Sn-base alloy all fell within a narrow range (about 4 to 7 Brinell) at 200° C. The data indicate that the Pb-base alloys containing upwards of 2 % Sn are more resistant to pounding at 150° C. than the tin-base alloys. The Pb-base alloys containing 5 % or more of Sn excel the Sn-base alloy in this same respect at 200° C. Notched-bar Izod impact tests at elevated temperatures substantiate the conclusions drawn in the paper that the Pb-base alloys are weaker than the Sn-base metals. Considerable additional data are presented. In further discussion, the Magnus Company states that the German alloy "Bahnmetall' or "railroad metal" containing about 0.6 % Ca, 0.6 Na, 0.03 Li, 0.10 Al and balance Pb practically replaced Pb- and Sn-base babbitt metals in Germany during the World War. In recent years its use has been limited on account of the extreme care necessary in melting. A modification of this alloy, however, is now available commercially. WAT (29)

Industrial Gas Research in Scaling of Steel at Heat-Treating Temperatures. Clair Upthegrove. *Western Machinery World,* Vol. 22, Oct. 1931, pages 442-443.

Tests were carried out at the University of Michigan under the auspices of the American Gas Association. The experimental procedure was identical with that used by Jominy and Murphy for work at forging temperatures (*Transactions A. S. S. T.,* Vol. 18, 1930, pages 19-57). The steel tested was S. A. E. 1015. Tests made with increasing time show, as would normally be expected, that the amount of scaling increases with the length of time that the steel is exposed to the scaling medium. The rate of scaling, however, decreases with increasing time and with atmospheres of O and dry air, and at a temperature of 1520° F., the curve showing the change in rate is of the parabolic type. At the same temperature and with an atmosphere of carbon dioxide the curve showing the increase in the amount of scale appears to be a straight line. WAT (29)

The Creep of Materials and Creep Stresses. Jas. Cunningham. *Steam Engineer,* Vol. 1, Jan., 1932, pages 162-163.

General discussion. AHE (29)

The Trend of Progress in Great Britain on the Engineering Use of Metals at Elevated Temperatures. R. W. Bailey (Metropolitan-Vickers), J. H. Dickenson (English Steel Corporation), N. P. Inglis & J. L. Pearson (Synthetic Ammonia and Nitrates). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 218-244.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 192. In the discussion it is suggested that when very minute plastic changes are being considered in design work, instead of taking "rate of creep," it would be more precise to use "total creep." Steels at temperatures below 1000° F. have a tendency to show comparatively high primary and small secondary flow at reasonable design stresses. In many cases after the initial creep appreciably small further creep takes place. The primary creep can in such cases be regarded as the total creep. In all designs requiring a high stability of dimensions stress analyses should therefore be made on a basis of total creep. The University of Michigan presents data on elevated temperature torsion tests of tube materials. The loading apparatus and measuring equipment used in making these tests are shown. A mathematical analysis which, in a modified form is shown in the formula, expresses the relationship between shear stress, f in lbs./in.^{2}, shear creep rate Φ in strain/hour, the temperature Θ in ° F., and e, the base of Napierian logarithms.

$$f = \frac{8.7 \times 10^6}{e^{0.006(-)}} \left(\frac{\Phi}{2}\right) 0.15$$

Another discusser states that up to about 800° F. the characteristics of tension and torsion are almost identical, but beyond 800° F. they differ quite widely. In the author's closure, it is suggested that this departure in agreement above 800° F. is due to a difference in the rates of straining. WAT (29)

The Electrical Conditions of Hot Surfaces During the Absorption of Gases—Carbon and Copper Surfaces at Temperatures up to 850° C. G. I. Finch & J. C. Stimson. *Proceedings Royal Society,* Vol. 132, 1931, pages 192-199.

The electrical conditions of a carbon rod and a Cu sheet have been studied at temperatures up to 850° C. in vacuo and in contact with various gases. The carbon rod does not exhibit constant and reproducible surface potential values until after the initial evolution of occluded gases has ceased. It is suggested that the emission of gas results in structural changes occurring in the surface and that such gas is probably chemically bound by the surface. The Cu sheet is not "normalized" until some time after the slight initial gas evolution has ceased so that in this case sintering is probably taking place. Copper oxide completely blankets the surface of the metal, so that it does not exhibit a surface potential either in a vacuo or in contact with oxygen. Evidence is obtained that the charge acquired by any of the surfaces examined tend to approach zero as the "normalization" temperature is increased. It is found that at 850° C. the values of the surface potentials on the metal surfaces fall into three distinct groups, (1) oxygen, (2) vacuo, nitrogen, argon, and carbonic oxide, and (3) hydrogen. At this temperature the specific effect of the surface potential appears to be very much reduced, and the value obtained is largely determined by the nature of the gas with which hot surface is in contact. WAT (29)

Needs of the Oil Industry for Metals at High Temperatures. E. S. Dixon (Texas Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 66-99.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 191. In the discussion it was pointed out that it would be worth while to obtain further replies to Dixon's questionnaire and amplification of those received. Attention is directed to the fact that the stresses producing creep in cylindrical vessels are not entirely simple tension stresses. Thermal conductivity, expansion and fatigue are important and should be considered simultaneously with creep. Many of the replies to the questionnaire were uncertain of the actual operating temperatures. A greater effort should be made to obtain such data. A summary of the annual steel tonnage used in the United States in the oil refining industry on the basis of a normal year, as compared with the year 1931, is presented. Another discusser states in order to develop maximum resistance to corrosion the 18-8 Cr-Ni steel should be heat treated. Experience has shown the 24-12 Cr-Ni alloy to be more resistant to sulphur attack. Of the thousands of tubes of the low-carbon 18-8 Cr-Ni alloy in service there have been but approximately 12 failures. These have been traced to overheating as result of lack of sufficient temperature control. The Standard Oil Company of Indiana considers pressure, temperature and corrosion the most important factors to be considered. Thermal expansion and a high degree of ductility are of less importance. At present, pressures do not exceed 1500 lbs. and metal temperatures should not have to operate above 1250° F. This company does not feel that a warning before failure is a necessary qualification of the metal. The Calorizing Company presents data taken from a typical still showing the life of tubes at elevated temperatures. It is shown that it is the relatively short period at higher temperature at the end of the cycle that determines the life of the tube more than the normal operating temperature. The tubes operate for 90% of the time in a stress range which would give from 10,000 to 100,000 hours of life with only 1% elongation. Data is also presented on tensile strength to 1800° F on an alloy containing not less than 20% Cr, 8 Ni, not over 1.2% C, and Al from 0.5 to 8.0% depending on the type of casting and service. This material holds its room temperature strength up to 1200° F. and is highly resistant to sulphur attack. Still another discusser states that their crude oil is not corrosive and therefore plain C steels are satisfactory provided necessary operating precautions are taken. The problem is very complex and each refiner must treat his needs separately. WAT (29)

Steam Turbine Materials for High Temperatures. R. C. Allen (Westinghouse Electric & Mfg. Co.). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 30-48.

For abstract of paper see *Metals & Alloys,* Vol. 2, Dec. 1931, page 324. In the discussion it is pointed out that in tensile creep tests of carbon steels if the temperature is increased from 750° to 850° F. the stress should be lowered 60% of the previous value in order to keep the creep rate unchanged. Data on creep tests in tension are not always entirely satisfactory; creep tests in torsion are necessary. For satisfactory design work at high temperatures, formulas are needed which will take care of creep of the material and give the dimensions of parts as a function of the allowable creep. Similar formulas are needed for bending and torsion. In this manner rational stress calculation taking creep into account will result in more economical machine structures. Another discusser states that the strength of silver solders at elevated temperatures is not important in general use. However, research work carried out by Handy & Harman on the strength of silver-soldered butt joints on stainless steel made with an oxy-acetylene torch showed an average breaking strength on 12 test bars of 70,000 lbs./in.^{2} at room temperature. 12 other specimens gave an average value of 13,400 lbs./in.^{2} at 1000° F. If silver-soldered joints are likely to be subjected to elevated temperature, careful tests should be made under conditions approximating the actual service if possible. WAT (29)

Engineering Requirements in the Automotive Industry for Metals Operating at High Temperatures. A. L. Boegehold (General Motors Corp.) & J. B. Johnson (Army Air Corps). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 169-200.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 192. In the discussion it is stated that the use of a cast iron containing Al which can be nitrided to give very hard surfaces has been neglected in making cylinder blocks, as well as pistons. Cr plating the bearing surfaces of crankshafts, pistons and the like should materially lengthen the life of such parts. The greater cooling rate offered by Al pistons reduces the effective pressure so that the power developed may not be appreciably increased by the higher compression ratio allowable with Al pistons. Electroplating about a 0.001 inch thickness of Sn on the skirt of cast iron pistons is a recent innovation in piston practice and is claimed to offer improved car performance. It is strongly emphasized that over 0.5% Pb in Babbitt is very detrimental at temperatures approaching 400° F. Cu over 3 % has an embrittling effect at such temperatures. Attention should be given to the materials for brake drums as increasing car speeds have subjected these parts to temperatures as high as 800° F. The British Aluminum Co. states that an Al alloy containing 1.3 % Cu, 2.2 Si, 1.3 Ni, 1.0 Fe, 0.1 Mg and Ti, known as RR50, has good casting properties, shows high impact fatigue resistance and maintains a fair degree of strength at high temperatures. This alloy is used in many leading aircraft engines in England. Forged pistons in engines of a heat treated aluminum "Y" alloy (similar to alloy H, A.S.T.M., B26-30T) shows favorable characteristics. It is also stated that cast iron pistons wear even longer when no dirt is admitted to the engine. There seems to be no doubt that the life of cast iron pistons is double that of Al pistons. WAT (29)

Impact Characteristics of Steel Rails at Low Temperatures. J. F. Cunningham & J. Gilchrist. *Rolling Mill Journal,* Vol. 5, Nov. 1931, pages 731-732.

Tests are described made to ascertain the behavior of rails at low, sub-zero temperatures at which many fractures occur; tests were made on new and used rails. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 325. Ha (29)

Extreme-Temperature Metals. H. W. Gillett. *A.S.T.M.-A.S.M.E. Joint Research Committee Symposium on the Effect of Temperature on the Properties of Metals,* Feb. 1, 1932, *Preface; Mechanical Engineering,* Vol. 54, Feb. 1932, pages 113-114.

Abridgment of preface to the above symposium published in book form jointly by the American Society for Testing Materials and the American Society of Mechanical Engineers. It is pointed out that the keynote to the whole symposium is found in the opening paragraph of the first paper, where Kerr states that the engineer who now has immediate requirements in advance of what can be supplied will make those requirements still more stringent in the future. Very few of the alloys listed in the 1924 symposium as most promising for high temperature service, have survived in 1931. They have been replaced by better alloys. While Cr and Ni are the vital elements in high temperature alloys considerable attention is directed to the use of W and Mo as well as nitrided steels. Mention of Konel metal which bids fair to show outstanding creep resistance, brings Co also into the picture. Boegehold and Johnson indicate that the automotive engineer would be receptive to Be-Al piston alloys. Much further research is needed to develop high-temperature data on cast iron and on many Al- and Cu-base alloys. Spooner and Foley find sufficiently numerous data on long-time tests so that they discard entirely all quick-pull tests as of too little value to cite. While many papers express an implied or an explicit desire for an accelerated creep test, there is a general feeling that the little knowledge obtained by the various short-cut methods so far developed is a dangerous thing. The warnings of Bailey and of Chevenard that it is still prudent to draw conclusions only from truly long-time tests indicate that careful foreign thought is in agreement with the cautious attitude of most American investigators. Bull indicates that foundry practice governs the high-temperature service of cast alloys as much as the alloy composition. It is pointed out that large crystal size is advantageous, as in a cast structure as compared with a forged structure. Chevenard points out further that increasing doubt is being thrown on the existence of anything that can properly be termed a creep limit. Comparison is now more commonly made on the basis of some defined rate of creep, or of no perceptible creep within a certain precision of measurement. WAT (29)

REDUCTION METALLURGY (31)

Blast-Furnace Reactions. COLIN DUNCOMBE ABELL. *Foundry Trade Journal*, Vol. 45, Dec. 10, 1931, page 362.

A paper presented before the West Yorkshire Branch of the Institute of British Foundrymen. The address dealt with several aspects of the cold-blast-furnace process not usually discussed in text books. OWE (31)

Production of Lead-Tin Alloys from Tin Slags. (Die Herstellung von Bleizinnlegierungen aus Zinnschlacken.) E. R. THEWS. *Die Metallbörse*, Vol. 21, Jan. 3, 1931, pages 3-4.

Twelve different economic and metallurgical factors controlling the success of the melting process are pointed out. The utilization of Sn-bearing Pb ashes, the use of oxidized Pb ores, the influence of As, the adoption of charcoal, the composition of the charge, the alloys obtained and the melting of a Sn-Fe alloy are covered. EF (31)

Limiting Factors in Quicksilver Metallurgy. C. N. SHUETTE. *Engineering & Mining Journal*, Vol. 132, Nov. 9, 1931, pages 398-400.

Progress in the metallurgy of Hg has been directed principally toward reducing the limit imposed by the lowest grade of ore that may be treated profitably. The principle progress has been in the development of furnaces for the treatment of finely divided low-grade ore. The design of the condensers is highly important. Economic figures are presented. WHB (31)

Roasting of Spathic Iron Ore in a Shaft Furnace (Das Rösten von Spateisenstein im Schachtofen mit Aussenfeuerung). E. VOGEL. *Stahl und Eisen*, Vol. 51, Dec. 3, 1931, pages 1504-1505.

In calculating the best economic conditions in roasting spathic ore in a shaft furnace with heating gases and cooling the roasted material by air, it was found that the fuel consumption is lower, the lower the temperature at which the ores are discharged and the more complete is the oxidation of the ores in the shaft. Therefore, it is necessary to use a great excess of combustion air and great volumes of cooling air. GN (31)

Progress in the Reduction and Refining of Copper during 1930. FRED. LAIST. *Mining & Metallurgy*, Vol. 12, Jan. 1931, pages 47-49.

New Cu plants, smelting processes, heat economy and waste heat recovery are considered. Ha (31)

Correlated Data of Blast Furnaces. (Hochofenzahlen und ihre Beziehungen zu einander.) A. WAGNER & A. HOLSCHUH. *Archiv für Eisenhüttenwesen*, Vol. 5, Dec. 1931, pages 279-290.

The report checks the formula which has been developed by E. C. Evans & F. J. Bailey to calculate the consumption of C for melting pig Fe in the blast furnace (*Journal Iron & Steel Institute*, Vol. 117, 1928, pages 53-144; E. C. Evans, L. Reeve & M. A. Vernon, *Journal Iron & Steel Institute*, Vol. 123, 1931, pages 95-181; G. Eichenberg & R. Hahn, *Archiv für Eisenhüttenwesen*, Vol. 3, 1929/30, page 213). It contradicts the assumption of Evans and Bailey that the heat losses through radiation are related to the area of the hearth but shows that the heat efficiency of the blast furnace is greatly affected by the radiation losses/ton of pig Fe. The findings of Evans and Bailey on the influence of the moisture of the combustion air upon the C consumption/ton of pig Fe need further study. The consumption of C was found to be lowest during winter, whereas the content of moisture of the air attains its minimum during the winter. GN (31)

The Thermal Dissociation of Pyrite. (Dissociation Thermique de le Pyrite.) LOUIS D'OR. *Journal de Chimie Physique*, Vol. 28, July 1931, pages 377-408.

Pyrite on thermal dissociation passes through the following systems: a complex gaseous phase, consisting of various kinds of sulphur molecules, S, S_2, S_6 and S_8; a primary solid phase which is the pyrite itself, in hemihedral cubes; a second phase (solid) which is a solution of S in FeS, in holohedral hexagonals. These 3 phases give place to a monovariant equilibrium. The partial pressures of the different kinds of molecules may be calculated by the following formula: $p = T \times 10^{-\frac{A}{T} + B}$

For S_2, A = 13,380 B = 13.8205 (p in mm.Hg)
For S_6, A = 26,464.5 B = 26.4195
For S_8, A = 33,170 B = 32.246
} first approximation

The pressure of the S is negligible as compared with that of the other constituents. The results of a study of the dissociation by means of a spiral quartz manometer, very carefully and accurately installed and controlled are shown diagrammatically. A preliminary series of measurements was made on the hexadiedral crystalline pyrite, a second series on triglyph pyrite. The deduction of equations for partial pressure was based on the hypothesis that the only constituents of S fumes are S, S_2, S_6 and S_8. The work reported indicates that there is still another kind of S molecule which Preuner and Schupp's work did not show and which occurs between the equilibria in the dissociation of the pyrite. But, as in the conditions of that equilibrium, this molecule only seems to play a secondary part; higher values for the coefficients of the pressure equations may be adopted in the primary approximation. As for the equation $P = \Sigma p$, with the coefficients mentioned, it represents faithfully enough (within limits of experimental error), the total pressure measured. The reaction FeS + S fumes $\rightleftarrows FeS_2$ is easily brought about in the 2 directions at temperatures of not less than 500-730° C. Below 500° the recomposition of the pyrite takes place slowly. The mechanism of the reaction is multiple; consideration of the structure of the pyrite shows that it is probable that the S can disengage itself from the pyrite directly to the molecular state S_2, and allow the dissociation to take place simultaneously according to: Pyrite $\rightarrow$ pyrrhotite + S: and Pyrite $\rightarrow$ pyrrhotite + S_2, the former process increasing in importance as the temperature rises. MAB (31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Enamel Containing Antimony for Cooking Utensils. HUGO KUHL. *Glashütte*, Vol. 60, 1930, pages 886-887.

In most enamels, antimony exists in its trivalent state which is most stable. The pentavalent compounds are converted into trivalent compounds by the loss of oxygen during fritting, long firing or high temperatures. 3% solutions of tartaric acid or 4% acetic acid dissolve antimony from enamels in very small quantities. WAT (32)

Testing of Paints for Bending Strength and Adhesion (Zur Prüfung von Anstrichen auf Biegefestigkeit und Haftvermögen). R. KEMPF. *Oberflächentechnik*, Vol. 8, Dec. 1, 1931, page 247.

An apparatus is described in which a thin steel ribbon on which the paint to be tested is put is continually moved in an S-shape between 2 rollers so that the paint is bent first one way, then the other alternatingly. It can be used for other materials, also. Ha (32)

Concrete Coverings Used for Pipe Lines. J. F. HOUGH (Portland Cement Association). *Oil & Gas Journal*, Vol. 30, June 4, 1931, pages T-78-84.

The advantages of a concrete coating for pipe lines are protection against corrosion, elimination of soil stress effect found in bituminous coatings, addition of strength to the pipe, prevention of "floating" of gas pipe out of the trench, creeping of pipe in the trench will not disrupt the cement coating, and quickness of application. VVK (32)

The Technique of Vitreous Enamelling. J. E. HANSEN. (Ferro Enamel Corp.). *Sheet Metal Industries*, Vol. 5, May 1931, pages 23-29; June 1931, pages 97-103; July 1931, pages 179-182; Oct. 1931, pages 423-428; Dec. 1931, pages 557-560.

Handbook concerned with wet process enamelling. The classification of enamels is given, i. e., one-coat agate or granite ware, etc. Selection and fabrication of enamelling materials and the importance of the design of parts to be enamelled are discussed. Part II. The preparation of the pieces for enamelling. The author recommends that mold facings be omitted and discusses pouring practice, cleaning of the work, and cupola practice. Part III. The pickling and cleaning processes. A 6% solution of H_2SO_4 heated to 140°-150° F. is recommended over one of 11% muriatic acid. Part IV. Enamel mill room practice is treated. The author recommends that a sufficient number of mills be installed so as to avoid repeated cleaning for color changes or enamel changes. Need for uniform mill practice is stressed and the ill effects of too small a mill charge are shown in the fifth part. Color matching and the methods of obtaining definite colors in both sheet iron and cast iron enamels constitute the major portion of the article. AWM (32)

Development of Low-Temperature Enamels on a Fluoride Eutectic Basis. JOHN F. HUNT & R. M. KING. *Journal of the American Ceramic Society*, Vol. 15, Feb. 1932, pages 116-121.

Three fluoride eutectics were substituted for cryolite and fluorspar in three standard enamels: sheet-steel ground coat, sheet-steel cover coat, and cast iron single coat, with a view to lowering their maturing temperature. Substitution in ground coats produced inferior enamels, but no apparent change was evident in cast iron enamels. In the case of sheet-steel cover coats satisfactory enamels were obtained with a maturing temperature 150° F. lower than the original enamel which matured at 1450° F. WAT (32)

Viscosity Control of Machine Coatings. F. J. GAVIN. *Metal Cleaning & Finishing*, Vol. 3, Feb. 1931, pages 137-138.

The methods of controlling the viscosity by first accurately determining the rate of solvent loss and then providing means of adding definite and correct portions of thinning materials is discussed. Ha (32)

Primers, Pigments and Paints. (Farbenbindemittel, Farbkörper und Anstrichstoffe.) W. HUSSE. *Zeitschrift Verein Deutscher Ingenieure*, Vol. 75, Oct. 31, 1931, page 1373.

The properties required for rust-proof coatings are discussed and the nitro-cellulose lacquers especially investigated as to their suitability and which methods are best applied for their use. Ha (32)

Paint as a Protective Medium for Iron and Steel. ERNEST S. HEDGES. *Chemical Age*, Vol. 25, Aug. 15, 1931, pages 148-149.

Adherence and functions of the paint film; protective effect of pigment; effect of corrosion products. VVK (32)

Finishing Aluminum Shingles. F. J. GAVIN. *Metal Cleaning & Finishing*, Vol. 3, Jan. 1931, page 55.

The article gives a complete description of the process of applying enamels to the surface of aluminum shingles. Ha (32)

Metals and Mortars. (Metalle und Mörtelstoffe.) D. DIECKMANN. *Tonindustrie Zeitung*, Vol. 55, Oct. 29, 1931, pages 1211-1212.

The rust protection of iron by concrete is critically discussed and the detrimental effect of the "Sorel" cement ($MgO + MgCl_2$ solution) as well as the corrosion acceleration by gypsum are criticized. The reverse behavior towards lead is pointed out. EF (32)

The Use of Turpentine and Volatile Thinners in Finishing Materials. R. W. BRANDT. *Metal Cleaning & Finishing*, Vol. 3, Jan. 1931, pages 59-60.

Production and use of turpentine, benzine, benzol and others is discussed. Ha (32)

Protection of Aviation Materials by Means of Paints, Varnishes and Dopes. (La protection des materiaux en aeronautique au moyen de peintures, vernis, enduits). G. DIXMIER. *Revue de Metallurgie*, Vol. 28, Dec. 1931, pages 690-694.

Good check on adherence and continuity of coating substances can be obtained by making the base metal a pole in the properly devised electric circuit, immersing it in a salt solution, placing the second electrode into the solution and deforming the base metal until the continuity of the protective film is destroyed, closing the circuit. For deformation a Guillery machine (a modification of Erichsen) is quite suitable. Curves obtained with different varnishes on the same base and with the same varnish but on differently finished base are given. JDG (32)

MANUFACTURERS' LITERATURE REVIEWS

364 **Testing Machine**—The Steel City Testing Laboratory, Detroit, Michigan, has prepared a leaflet describing their Universal Hydraulic Testing Machine, Type MP 10. This machine is for tensile, elasticity, compression, bending, folding, shearing, punching and Brinell hardness tests.

365 **Air Tools**—Catalog AT 2000 of the Madison-Kipp Corporation, Madison, Wis., is devoted to their chippers, filers, grinders and accessory parts for these tools. It includes a description of their steel writer which writes on glass or steel almost as quickly as writing with a lead pencil.

366 **Shears**—Bulletin E-902 of the United Engineering & Foundry Co., Pittsburgh, Pa., illustrates and describes their various types of light shears of inexpensive construction for use in the rolling mill.

367 **Grinding**—An interesting article in the March issue of *Grits and Grinds*, published by the Norton Company, Worcester, Mass., is entitled "Grinding Alloy Steel Bar Stock by the Centerless Method."

368 **Furnaces**—Bulletin No. 329 of the W. S. Rockwell Co., 50 Church St., New York, N. Y., discusses their continuous furnaces of the pusher type, both electric and fuel fired. Several pages are devoted to sketches showing designs which have been developed to meet different requirements.

369 **Magnetic Switches**—The General Electric Co., Schenectady, N. Y., has just issued an attractive bulletin, No. GEA-1568, showing their different types of magnetic switches. The construction of these switches is illustrated.

370 **Lead**—The March issue of this publication of the Lead Industries Association, Graybar Building, New York, contains several write-ups on unusual and interesting uses of lead, including lead faced building blocks, lead sidewalk flashing and lead-asbestos anti-vibration pads.

371 **Arc Welding**—An 80-page booklet prepared by The Hobart Brothers Co., Troy, Ohio, is designed to present such facts about the electric arc welding process as are essential to its successful application to practical work. It is a brief, logical and non-technical manual.

372 **Gas Carburizing**—A recent pamphlet put out by the Surface Combustion Corp., Toledo, Ohio, contains a reprint from the April issue of *Metals & Alloys*. It is a description of the continuous gas carburizer, installed at the Chrysler Corporation's plant at Newcastle, Indiana.

373 **Bright Annealing**—A leaflet distributed by the Electric Furnace Co., Salem, Ohio, describes the Preeco special atmosphere electric furnaces for bright annealing in one operation.

374 **Welding Electrodes and Accessories**—Bulletin GEA-1546 of the General Electric Co., Schenectady, N. Y., illustrates the proper applications of their electrodes. A portion of the booklet is given over to a list of their welding supplies and accessories.

375 **Circuit Breaker**—The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has issued two 8-page circulars on its new line of "De-ion" circuit breakers. These breakers use a new method of arc extinction that enables elimination of all fuses in panelboards, distribution switchboards within the breaker's capacity and industrial applications where fused safety switches are now used. Circular 1939 contains a general description of the new breakers and Circular 1937 gives construction and application details of the 225-ampere breaker.

376 **Arc Welding Supplies**—A new 24-page bulletin, No. 3304, of the Lincoln Electric Co., Cleveland, Ohio, gives a full description with prices of electrode holders, cables, protective lens, protective clothing and various supply parts as well as electrodes for all kinds of welding.

377 **Testing and Balancing Machines**—Catalog 50-Part H of the Tinius Olsen Testing Machine Co., Philadelphia, Pa., is a 116-page book devoted to their miscellaneous testing machines for efficiency of cutting or abrasion tools, alternate stress in materials, impact, torsion, cold bend, hardness, as well as for oils and bearing metal and other special purposes. The price of this catalog is $1.00.

378 **Thermalloy**—Bulletin 100 of the Electric Alloys Co., Elyria, Ohio, gives the analyses of the various grades of Thermalloy, and a short description of the physical properties of each type. These are heat and corrosion resistant alloys.

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METALS & ALLOYS, 3619 Forbes St., Pittsburgh, Pa.

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ALPHABETICAL INDEX TO ADVERTISERS

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379 **Molybdenum in 1931**—This booklet, published by the Climax Molybdenum Co., 295 Madison Ave., New York, N. Y., is divided into three parts. The first is a reprint of an article, "Molybdenum, Today and Tomorrow," which appeared in *Metals & Alloys*, the second is a selected bibliography, and the third describes some of the work of their own laboratory.

380 **Welding**—A feature article in the May issue of *Oxy-Acetylene Tips*, published by the Linde Air Products Co., 30 East 42nd St., New York, is entitled "Controlling Expansion and Contraction." Another interesting article in the same issue is "Inexpensive Automotive Repairs."

381 **Refractories**—A new catalog No. 232 issued by McLeod & Henry Co., Troy, N. Y., describes various types of super-refractory blocks and bricks, as well as complete settings made of silicon carbide. The catalog includes, in detail, the manufacturing processes for silicon carbide refractories, their physical characteristics, advantages, limitations and a description of applications for industrial furnaces, kilns, muffles, etc.

382 **Electric Immersion Heating Units**—Bulletin No. 270 of H. O. Swoboda, Inc., Pittsburgh, Pa., describes their bare electric immersion heating units for asphalt, pitch, oil, varnish and similar viscous substances with electric insulating qualities.

383 **Roll Polisher**—A folder issued by the Aetna-Standard Engineering Co., Youngstown, Ohio, contains several photographs which demonstrate the mechanical features of their equipment for polishing sheet and tinplate rolls.

384 **Nickel Comparator**—The Kocour Co., 4724 S. Turner Ave., Chicago, Ill., has issued several leaflets and booklets describing their apparatus for the determination of the nickel content of electroplating and electrotyping solutions. They also supply a test set for determining the relative strength of alkaline cleaner solutions.

385 **Abrasives**—A booklet published by The Carborundum Co., Niagara Falls, N. Y., entitled "Abrasive in the Service of Industry" gives a short historical sketch of the art of shaping and finishing metals by grinding, including a discussion of present day practice and ending with a short chapter on the possibilities of the future.

386 **Die Steel**—The Research Department of Ludlum Steel Co., Watervliet, N. Y., has issued a "Blue Sheet" which contains brief but detailed information concerning the physical properties and characteristics of Ontario air hardening die steel. It includes tabulated and charted results of tests conducted on the steel.

387 **Protective Coating**—The Quigley Co., Inc., New York, N. Y., has prepared a booklet discussing their Triple-A Protective Coating, and giving a list of many industries now using this coating to meet their corrosion problems.

388 **Copper & Brass Bulletin**—The April issue of this publication of the Copper & Brass Research Association, 25 Broadway, New York, describes many things made from copper and brass, from the copper roof of a Chinese temple to items made of copper and brass available in the 5 and 10 cent stores.

389 **Metallurgical Microscope**—Clay-Adams Co., Inc., New York, N. Y., has issued several mimeographed sheets giving complete specifications for their metallurgical projector, microscopic and micro-photographic apparatus which they call "Opacus." Illustrations of the apparatus are shown and prices for it and its accessories are given.

390 **Foundry Practice**—The feature article of the April issue of *Better Methods*, published by The Beardsley & Piper Co., Chicago, Ill., is entitled "Producing Castings for Dry Process Enameling." The several other articles in this issue will also be of interest to foundrymen.

391 **Testing Machines**—Bulletin No. 28 of the Baldwin-Southwark Corp., Philadelphia, Pa., is a 36-page pamphlet which gives a short historical sketch and development of the machines and full description with illustrations and diagrams of their 20,000-100,000 lb. testing machines, the 200,000-600,000 lb. machines and those for 600,000 lb. and up.

GENERAL (0)

Sheet Steel and Tin Plate. R. W. SHANNON. Chemical Catalog Co., New York, 1930. Cloth, 6¼ x 9¼ inches, 285 pages. Price $5.00.

Shannon's book is the only one of its kind that has come to our attention. There are many well-known publications relating to the metallurgy and heat treatment of steel, the processes involved in shaping and preparing it for subsequent use, and the methods of applying protective coatings to various steel products, but this treatise fits comfortably into a niche that has not been filled heretofore. Any one who reads the book in the interest of learning more about sheet steel and tin plate will not be disappointed. The subject matter has been well chosen and is treated to good advantage throughout the volume.

It is particularly fortunate that the author decided to handle his subject primarily for the guidance and benefit of the consumer. With the extensive diversity of products and grades now produced to meet the requirements of the trade, a descriptive guide of this kind is unquestionably valuable. For all those who use or contemplate the use of sheet steel and tin plate in any way—for engineers, architects, purchasing agents, writers of specifications, sheet metal workers, dealers, salesmen, and students of the subject—here is a fund of information that will be usually helpful.

The reviewer's emphasis on the foregoing feature is not intended to divert attention from the other useful elements in the book. The foundation for the special treatment of the subject has been well laid by a discussion of each successive and essential step in the process of production. The reader can obtain, from the earlier chapters, a very good understanding of the various methods employed in the industry and the bearing they have upon the properties of the finished products.

The few technical inaccuracies encountered in this work are relatively unimportant from the standpoint of the consumer and do not detract from the general value of the publication. Incidentally, even those who are well informed on the subject will find the descriptive matter and various compilations of data convenient for ready reference.
R. E. Zimmerman (0)-B-

Metallurgie. Agenda Dunod 1932. R. CAZAUD. Dunod, Paris, 1932. Cloth, 4½ x 6 inches, 371 pages. Price 20 Fr.

The 48th edition of one of a series of handbooks on various phases of technology, engineering, industry, and commerce, this volume is intended to serve managers, engineers, superintendents, foremen, etc.

Admittedly, limitation to less than 400 very small pages renders most difficult the description, even briefly, of the raw materials, equipment, and processes for the preparation of the common and semi-rare metals, their statistics and the properties and uses of them and their alloys. As a result, some subjects have received proportionately too detailed treatment and others insufficient. For example, there are drawings of almost every type of electric melting and refining furnace and of an electric iron reduction furnace, but none of a blast furnace or open hearth or Bessemer converter. Tables show the dimensions of standard structural shapes but there is not treatment of hot and cold working. The sketchy character and sense of incompleteness thus resulting in parts of the book could have been completely avoided by slight rearrangement and perhaps 50 additional pages of text.

On the other hand, principles of each subject discussed are very clearly presented and classification of materials and processes used to introduce many of them. The treatment of metals other than iron seems in most cases better balanced.

Subjects considered are metallurgical agents (fuels, refractories, slags), apparatus (furnaces, blowers, etc.), thermal control (pyrometry and gas analysis), metallurgy of iron (cast iron, wrought iron, steel), electrometallurgy (reduction, refining, melting), mechanical testing, physical metallurgy (equilibria, micrography, macrography, heat treatment), and metals other than iron (preparation, alloys and uses of Cu, Pb, Zn, Cd, Sn, Ni, Co, Sb, Hg, Al, Mg, Bi, Be, Au, Ag, Pt, Cr, Mo, Mn, W, V, Ti, Zr. Jerome Strauss (0)-B-

English Terms Used for Gears. (Englische Bezeichnungen für Zahnräder.) FRITZ G. ALTMANN. *Maschinenbau*, Vol. 10, May 21, 1931, pages 351-354.

Some 200 German terms and their English equivalents, arranged in 2 sections, German to English and English to German, the former by subject, the latter alphabetically, are given.
MAB (0)

Chemical Composition, Shaping and Heat Treatment of Steel. (Chemische Zusammensetzung, Formgebung und Wärmbehandlung des Stahles.) H. BENNEK. *Die Wärme*, Vol. 54, Apr. 25, 1931, pages 300-304, Sonderheft "Werkstoff und Herstellung im neuzeitlichen Dampfkesselbau."

Structural changes and changes in physical properties due to the addition of the most important alloying elements. Relationship between rate of deformation and strength values. Recrystallization, aging and etching for stress flow lines. Purpose of heat treatment and possibilities of defects. Hardening through in relation to cross section and amount of alloying elements present. The paper which deals with the problems outlined above was presented before the Zentral Verband der Preussischen Dampfkessel Ueberwachungsvereine, 1931.
EF (0)

Practical Research Results on Non-Ferrous Metals. *American Metal Market*, Vol. 38, Aug. 1, 1931, pages 3, 10.

Reprinted from "Ten Years of Research for the Metal Industries," by British Non-Ferrous Metals Research Association. Researches are on atmospheric corrosion and tarnishing of metals and study of effect of impurities on Cu. Progress made in ternary Pb alloys for cable sheathing, water pipe, Al brass condenser tube, Sn solders, locomotive fire box and stay copper, brass castings, alloys for high temperature service, autogenous welding of Cu, annealing furnace practice, spectroscopic assay of metals, electro-deposition, gases in metals, galvanizing, die-casting alloys, condenser tube corrosion, Ni researches, Zn sheet, Al, Sn, etc.
DTR (0)

The Book of Metals. DONALD WILHELM. Harper & Brothers, New York, 1932. Cloth, 6¼ x 9½ inches, 341 pages. Price $4.00.

Some 35 eminent metallurgists have given the author correct technical facts in regard to iron, steel, alloy steels, aluminum, copper, brass, bronze, nickel, zinc, lead, tin, gold, silver and the platinum metals, and he has strung them together and rephrased them with the idea of making the facts understandable, in particular to two boys of 14 and 16, to whom the book is dedicated, and to others of the same mental age, as far as previous knowledge of metallurgy goes. The volume is said by the "Scientific Book of the Month Club" to be "breezy, non-technical and accurate."

We tried to get a 15-year old boy to read it, but couldn't persuade him to get more than half-way through it. Perhaps that was the fault of the boy and not of the book, or due to competition from various detective stories the boy was then reading of his own accord.

To the reviewer's mind, the somewhat flippant, "breezy" style in which Wilhelm tries to make the book a popular one by his own interpolations, adds nothing to the interest of the book, even to a youngster. Most youngsters dislike being "written down to," and the parts that are quoted more or less verbatim from writers like Jeffries, Frary, Welty, Stanley, Agassiz and Griffiths, which are clearly put but not written in advertising parlance, will probably appeal, both to young and old readers, more than Wilhelm's own part.

Due to the guidance of the metallurgists who have helped the author, the material is accurate in general. Reference to a "slope" instead of a stope in a discussion of mining, to an automobile "toppet" valve, and to the dimensions of Solomon's brass bowl "9 feet high and nearly 18 inches from brim to brim," are the only actual errors noted.

The few photographs by Margaret Bourke White are, of course, superb. These and the occasional relief from Wilhelm's style afforded by the quotations from others are the most attractive features of the book.

The material in the volume is good. We don't personally care for the type of sugar-coating used, but if any non-technical readers do want to know something about metals, this is an accurate book for them to read.
H. W. Gillett (0)-B-

Second and Third Supplements to the Non-Ferrous Metals Handbook. (Nachtrag II und Nachtrag III zum Werkstoffhandbuch Nichteisenmetalle.) Beuth Verlag, Berlin, 1931. Loose leaves, 5¾ x 8¼ inches, II, 28 pages, III, 28 pages. Price 3.15 RM each.

These additions to the German non-ferrous metals handbook cover compression testing, creep and fatigue testing, electroanalysis, potentiometric analysis, microscopy and macroscopy, lead, torsion testing, corrosion test methods, working of Al, electric melting furnaces, metallic coatings. They are quite brief, but cover the high spots and generally give a selected bibliography that will lead to more detailed information. The page on creep testing is not helpful. Most of the others are as accurate as can be expected with such brief treatment.
H. W. Gillett (0)-B-

Profitable Practice in Industrial Research. Edited by M. Ross. Harper & Brothers, New York, 1932. Cloth, 5¾ x 8¾ inches, 269 pages. Price $4.00.

Fourteen articles by directors of research are assembled into this book, which is published under the auspices of the National Research Council. Jewett and Mills of the Bell Laboratories, Kettering of General Motors, Whitney and Hawkins of General Electric, Mees of Kodak, Skinner of Westinghouse, Stine of duPont, Burgess of Standards, Weidlein of Mellon, Jackson of Massachusetts Institute of Technology, together with Sparagen, Holland and Little, discuss research from their own points of view.

These articles give a good picture of the usefulness of research and the general principles of operation of research laboratories in individual firms, government bureaus, universities, consulting laboratories and trade associations. The research programs of technical societies, such as the American Society for Testing Materials, might well have been given a chapter.

The book is useful to the research worker, but still more useful to the executive interested in the possibilities and limitations of research in adding to the profits of his firm. Research is a specialized business, requiring a certain type of worker, a certain environment, and a certain permanent position in the affairs of the firm utilizing it, if it is to pay dividends. The experience of experts who have made it pay is available in this volume.
H. W. Gillett (0)-B-

Limitations of our Fundamental Knowledge of the Properties of Metals. F. O. CLEMENTS. *Lecture at joint meeting American Society for Testing Materials and American Institute of Mining & Metallurgical Engineers*, Feb. 18, 1932. Advance copy, 7 pages. Mimeographed.

Popular-type discussion, sometimes jocular. Lists atomic structure, mechanism of hardening steel by quenching, reasons for variability in heat-treating of heats of similar chemical analysis, distortion on heat-treatment, catalytic action of metals, metals of high elastic modulus, high temperature properties, endurance of notched steels and of carburized steels, damping, wear, machineability, magnetic properties, etc., as subjects on which relatively little progress has been made compared to what is needed. Failure of the Ambassador bridge cables is cited as puzzling. Automobile engineers desire to build lighter vehicles; hence corrosion-resistant light alloys are needed.
HWG (0)

Seeks Better Understanding Between Blast Furnace and Foundry. T. F. KELLY. *Canadian Foundryman*, Vol. 22, Nov. 1931, page 7.

Brief article on the desirability of a better understanding between the foundry operator and the blast furnace man and, particularly, of better knowledge of the characteristics of the elements they are using.
OWE (0)

Photoelectric Properties of Zinc Single Crystals. J. H. DILLON. *Physical Review*, Vol. 38, 1931, pages 408-415.

An experiment is described in which the photoelectric properties of outgassed single crystals of Zn were studied. After the emitting surfaces of the crystal had been treated with ultraviolet light and some of the Zn evaporated thermally, a stable condition was reached. In this stable condition a difference in the long wave limits of the polycrystalline surface and cleft 0001 face of approximately 260 A.U. was observed. The results are discussed with regard to possible sources of contamination and the presence of occluded gas layers. WAT (1)

The Electrical Conductivity of Single Aluminium Crystals in Directions Inclined at Various Angles to the Crystal Axes. MALCOLM FRASER. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, July 1931, pages 112-129.

Single Al crystals were prepared by the method of Carpenter and Elam, consisting (briefly) of 2 heatings and one stretching. The purity was from 99.6 to 99.75%. The orientation of the crystal axes of the face-centered cubic system into which Al crystallizes were determined by the Laue spot method. Within the accuracy of the experimental methods (1%) the specific electrical resistance was found to be independent of the orientation relative to the crystal axes. It was about 1% greater than that of the annealed material from which it was prepared; this is ascribed to the solution of impurities in the long annealing process for preparing the single crystal. 10 references. Ha (1)

The Atomic Weights of Nitrogen and Silver. I. The Ratio of Ammonia to Silver. GREGORY PAUL BAXTER & CHARLES HERBERT GREENE. *Journal American Chemical Society*, Vol. 53, February 1931, pages 604-613.

If N is taken as 14.0078, the atomic weight of Ag calculated, is 107.879, while the value 14.008 for N gives 107.880 from the Ag:NH_3 ratio and 107.879 from the Ag:NO_3 ratio. MEH (1)

The Polymorphism of Zinc. L. ANASTASIADIS & W. GUERTLER. *Metals & Alloys*, Vol. 2, Dec. 1931, page 354.

A resume of the literature with a tabulation of the results reported by various investigators on this subject, with their methods. WLC (1)

Photoelectric and Thermionic Properties of Palladium. LEE A. DUBRIDGE & W. W. ROEHR. *Physical Review*, Vol. 39, Jan. 1, 1932, pages 99-118.

The photoelectric and thermionic properties of pure palladium have been studied during an extended outgassing in high vacuum. The threshold, obtained by extrapolation of special sensitivity curves, shifted from below 2300 A.U. to above 3000 A.U. and then back to a final value of 2486 A.U. as outgassing progressed. In the final state the photocurrents excited by monochromatic light increased with temperature; the relative increase was greater for the longer wavelengths. At the higher temperatures (1100° K.) the spectral sensitivity curves approached the axis asymptotically. The results are shown to be in excellent agreement with Fowler's recent theory and his methods of analysis yields the value 4.97 ± 0.01 volts for the true work function (2486 A.U.). The thermionic work function for the clean specimen was found to be 4.99 ± 0.04 volts, and the value of the constant A is very close to 60 amp./cm.^{2}deg.^{2}. WAT (1)

Physical and Chemical Properties of Rhenium. (Physikalische und Chemische Eigenschaften des Rheniums.) C. AGTE, H. ALTERTHUM, K. BECKER, G. HEYNE & K. MOERS. *Zeitschrift anorganische und allgemeine Chemie*, Vol. 196, Feb. 23, 1931, pages 129-159.

A comprehensive review of the properties of the new metal rhenium is given of which the most important points are: the metallic properties are similar to W (high melting point) and to Os (semi-rare metal, high ductility). Melting point 3440° ± 60° absolute. Specific electrical resistance 0.21 x 10^{-4} ohm. cm. = 15% (4 times greater than W); temperature coefficient between 0° and 100° = 3.11 x 10^{-3}. The electron emission between 1900° and 2700° absolute is only about ⅛ to ¼ that of W. It can be hot forged, rolled and hammered; tensile strength about 50 kg./mm.^{2} with 24% elongation. Heat expansion coefficient in the c-axis is 2.6 times greater than in an axis vertical to it; in β (001) = 12.45 x 10^{-6} ± 8%, and in β (100) = 4.67 x 10^{-6} ± 8%. Rhenium can be obtained by electrolysis in only very limited amounts as a cathodic coating. It is considerably more resistant to oxidizing gases than W. The presence of Re can be proven analytically by precipitating mercury-and thallium-perrhenate, or with brucine and veratrine. The line spectrum of Re is given and its presence can be detected by this means as well. The heat quantitative method is in the form of NH_4ReO_4. Rhenium metal is easily dissolved in HNO_3, slowly in H_2SO_4, and to a limited extent in HF and HCl. Carbides, nitrides and amalgams could not be formed. Ha (1)

Some Relation Among the Ferromagnetic Constants. J. R. ASHWORTH. *Proceedings Physical Society*, London, Vol. 42, Aug. 15, 1930, pages 449-452.

Attention is directed to a ferromagnetic equation written after the model of van der Waal's equation of state for fluids. It is shown that the ratios of the absolute critical temperatures to the maximum intensities of magnetization are nearly the consecutive numbers 2, 3, 4, 5, 6 for Fe, Co, Ni, Heusler's alloy and magnetite, respectively. A formula for the discontinuity of the specific heat at the critical temperature is derived which agrees well with experimental determinations and a simple formula is given connecting this discontinuity with the true specific heat at the critical temperature. Certain simple relations among the constants of ferromagnetism disclose themselves which show that the ferromagnetic properties of Fe and Ni are to one another as those of Co and magnetite. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 159. (1)

Rhenium (Rhenium). C. AGTE & K. BECKER. *Die Umschau*, Vol. 35, June 27, 1931, pages 520-522.

Discovery, present production, physical and chemical properties. EF (1)

Some Photoelectric Properties of Mercury Films. DUANE ROLLER, W. H. JORDAN & C. S. WOODWARD. *Physical Review*, Vol. 38, Aug. 1931, pages 396-407.

Films of very pure Hg were deposited slowly in a high vacuum on an oxidized Fe plate maintained at liquid air temperature. As each film increased in thickness, the photoelectric current excited by each of the Hg arc lines 2537A.U., 2653A.U. and 2700A.U. increased from zero to a maximum value and then decreased to a final constant value. In each the threshold wave-length at the time of maximum sensitivity was about 2750A.U. Its final value, that for a thick layer of mercury, was 2730A.U. ± 15A.U.; this did not change even when the Hg was allowed to melt, this confirming a former conclusion that the threshold wave-lengths for solid and liquid Hg are the same. There was no indication of a large shift in the threshold wave-length at any time during the formation of the films. WAT (1)

The Formation Heat of TiO_2 (Die Bildungswärme von Titandioxyd). W. A. ROTH & G. BECKER (Technische Hochschule Braunschweig). *Zeitschrift für physikalische Chemie*, Bodenstein Festband, 1931, pages 55-60.

Ti was burnt in the calorimetric bomb and the heat of formation determined amounted to +218.7 (±0.3) kg./cal. at a constant pressure. The formation heats of the dioxides of the IV group in the periodic system distinctly show a relationship to the number of order. EF (1)

Investigation of Aluminum Tubes. I. G. SHOULGIN. *U. S. S. R. Science Research Dept. Supreme Council National Economy* No. 448, 1931; *Transactions Central Aero-Hydrodynamic Institute*, No. 80, 1931, pages 1-16.

This investigation was carried out, by the section for testing aeronautical materials, for the purpose of elaborating a system of technical standards of Al tubes. The chemical composition and mechanical properties were determined. The tubes were grouped in 3 classes, according to chemical composition: (1) containing less than 1%; (2) 1-1.5%; (3) more than 1.5% of impurities. As regards the mechanical properties, it is concluded that these are influenced by external defects, and the system of testing employed must depend on the nature of the work performed by the tubes. Normalized tubes up to 20 mm. in diameter should be tested for tension in complete (that is, uncut) sections. Tubes of 20-30 mm. diameter may be tested both in complete and in flat sections. Tempered tubes up to 30 mm. in diameter must be tested uncut. The elongation under tension should be measured along a length of 10 diameters. Tests for elongation and cone-widening of the aperture are regarded as the most characteristic, although compression tests may also be employed. Crushing and bending tests are considered to be useless, as they give no indications of films, pinholes and other flaws. (1)

On an Electromotive Force Between Two Metals in Relative Motion. J. B. SETH, BHISHAMJI GULATI & SWARAN SING. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, Aug. 1931, pages 409-429.

The phenomenon that when 2 metals are rubbed together the seat of rubbing becomes a source of an electromotive force was thoroughly investigated. This is ascribed partly to the rise of temperature, the 2 metals forming a thermocouple and, partly, to the contact of the metals. In the tests, a rotating disk was used and the other metals pressed against it. 2 laws could be established: (1) the e.m.f. is proportional to the relative speed of the 2 rubbing surfaces; (2) the e.m.f. is independent of the pressure with which the 2 surfaces are pressed against each other. The tests are described and discussed in detail. 18 references. Ha (1)

The Behavior of Powdered Metals under Pressure. (Das Verhalten pulverförmiger Metalle unter Druck.) F. SKAUPY & O. KANTOROWICZ. *Zeitschrift für Elektrochemie*, Vol. 37, Aug.-Sept. 1931, pages 482-485.

Electrical conductivity was used as a means of elucidating the behavior of metallic powders in compressing and in sintering at high temperatures. See "Electrical Conductivity of Pulverized Metals under Pressure," *Metals & Alloys*, Vol. 2, May 1931, page 94. Ha (1)

Advances in the Production and Utilization of Some Rare Elements. (Fortschritte in der Darstellung und Anwendung einiger seltener Elemente.) W. NODDACK. *Die Metallbörse*, Vol. 21, Apr. 1, 1931, pages 603-604; Apr. 8, 1931, pages 651-652.

The following elements are treated more or less exhaustively in regard to history, occurrence, production, properties and present commercial importance: He, Ne, Ar, Kr, Xe, Li, Be, Ra, Ce, Ge, Hf, W, F, Rh and the platinum group. EF (1)

The Electron Theory of the Metals, I. and II. (Zur Elektronentheorie der Metalle.) L. NORDHEIM. *Annalen der Physik*, Series 5, Vol. 9, 1931, No. 5, pages 607-640; No. 6, pages 641-678.

The problem of the nature of metals is treated strictly theoretically on the basis of the Fermi-statistics in connection with the theories of Pauli and Sommerfeld. The physical prerequisities for the treatment of the electric and thermal conductivity on the basis of the length of the free path of electrons are explained and the fundamental equations for the thermo-electrical phenomena derived. The solution of this equation and the transition probabilities are discussed, and the results of the investigations can be summed up briefly as follows: Free electrons give a good approximation for the actual conditions of good conductors; Sommerfelds formulas are corroborated for high temperatures, and the free length of path for the electrons gives a useful means for explanation of the dependence of the electric conductivity on the temperature. The behavior of alloys can be satisfactorily explained by the new theory. The application of the theory is demonstrated by the example of an ideal crystal and by the comparison of calculated and observed conductivities of metals and some alloys. Ha (1)

Crystalline Boron (Sur le bore cristallisé). L. Hackspill, A. Stieber & R. Hocart. *Comptes Rendus,* Vol. 193, Nov. 3, 1931, pages 776-778.

The authors have prepared samples of boron containing at least 99% of boron, the material approximating arsenic in color, having a Moh's hardness of 9 and a density at 20° C. of 3.33 ± 0.01. A description is given of experiments they have carried out on the spectroscopic analysis (Debye-Scherrer) of this material. 2 diagrams. OWE (1)

Damping Capacity of Materials. G. S. von Heydekampf. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 157-175.

See abstract of preprint, *Metals & Alloys,* Vol. 2, Nov. 1931, page 256. Includes discussion in which de Forest points out that damping may give information on amount and distribution of non-metallic inclusions. Wrought iron has high damping capacity. Sturm points out that, in creep tests, an alloy of low rate of creep shows high initial set while one of higher creep rate shows lower initial set. This is illustrated by curves of Al-Mn and Al-Si alloys. Creep and damping capacity may be interconnected. HWG (1)

The Photoelectric Effect from Thin Films of Alkali Metal on Silver. Herbert E. Ives & H. B. Briggs. *Physical Review,* Vol. 38, Oct. 1931, pages 1477-1489.

The thin films of alkali metals which spontaneously deposit in vacuo on other metals have long been known to exhibit photoelectric effects which vary in amount and character, depending on the underlying material, but the exact nature of this dependence has been obscure. Ag, because of its region of exceedingly low reflecting power in the ultraviolet and the accompanying variation of optical constants, is exceptionally well suited for studying the influence of the underlying metal. It is found that the region of low reflecting power profoundly affects the photomission, but in a manner not to be explained simply by reduction of light reflected back through the alkali metal film or by the absorption of light by the Ag. The results are very satisfactorily explained upon computing, from the optical constants, the intensity at the surface, of the interference pattern formed by reflection just above the Ag surface. The positions of the maxima and minima of photomission, and their variations with angle of illumination and plane of polarization are accurately indicated. WAT (1)

The Theory of the Magnetization Curve of Isotropic Ferromagnetic Bodies in Medium and Strong Fields (Zur Theorie der Magnetisierungskurve isotroper Ferromagnetica in mittleren und starken Feldern). R. Gans. *Physikalische Zeitschrift,* Vol. 33, Jan. 1, 1932, pages 15-17.

Heisenberg, *Zeitschrift für Physik,* Vol. 69, 1931, page 287, developed a theory which permits the calculation of the magnetostriction of ferromagnetic single crystals and Akulow, *Zeitschrift für Physik,* Vol. 69, 1931, page 794, has used this theory to determine the magnetization curves of single crystals of iron. In connection with this theory, its application for the magnetization of ferromagnetic isotropic metals is discussed with special reference to cobalt. GN (1)

Stannite of Calcium, Strontium and Barium. (Stannite des Calziums, Strontiums und Bariums.) Setsuro Tamaru & Haruo Sakurai. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 195, Jan 7, 1931, pages 24-34.

The conditions under which Sn compounds can be obtained were investigated. With Ca, stannous Ca ($CaSnO_2$), Ca metastannate ($CaSnO_3$) and $CaSnO_4$ were formed. With the other elements $BaSnO_2$ and $SrSnO_2$ could be obtained in a similar manner; the process is described. Ha (1)

Electrolytic Investigations on Single Crystals of Zinc (Elektrolytische Untersuchungen an Zinkeinkristallen). K. H. Kreuchen. (University of Kiel). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 155, July 1931, pages 161-198.

The electrolytic behavior of an ideal crystal according to Kossel's theory of crystal growth is discussed in the introduction. Single crystals of Zn were prepared by the Bridgeman method. The (0001) cleavage plane in the freshly split state yielded a P.D. of 30 millivolts against the poly-crystal. The author presents his conception of surface potential, specific potential and equilibrium potential and succeeds in obtaining large single crystals of Zn by electrolytic orientated growth. Galvanic cells in which the Zn electrode was substituted by a single crystal yielded queer time/current curves, the course of which are interpreted by the author. EF (1)

Magnesium (Le magnesium). A. Dumas. *Journal du Four Electrique,* Vol. 40, Sept. 1931, pages 354-359; Dec. 1931, pages 474-476.

From 3 major methods proposed for production of Mg (electrolysis of chlorides, reduction at very high temperatures with carbon and electrolysis of magnesia) only the first is widely used. Since it is simple itself, the process depends for effectiveness on the methods for production of chlorides either in the monohydrated or anhydrous form. The former can be used as such or further dehydrated by using KCl. Recently, dry methods of chlorination of the oxides were introduced in which a mixture of globerite and coal is penetrated by the current of chlorine while heated to a high temperature. The Cl and $MgCl_2$ are evacuated. The Cl follows a closed cycle. $MgCl_2$ is electrolyzed in large tanks usually having a refractory lining and an independent set of electrodes. The second part gives the properties of Mg and some of its applications. JDG (1)

The Thermal Expansion and Atomic Heat of Solid Mercury. L. G. Carpenter & F. H. Oakey. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Aug. 1931, pages 511-522.

The investigation was made from — 73° C. to the melting point of Hg, i. e., — 39° C. The test arrangement is described in detail and the results of the cubic expansion coefficient and atomic heat are represented in curves. Ha (1)

Preparation of Pure Magnesium by Sublimation. (Préparation du magnésium pur par sublimation). J. Hérenguel & G. Chaudron. *Comptes Rendus,* Vol. 193, Nov. 3, 1931, pages 771-773.

The authors, requiring pure Mg for experiments designed to determine the corrodibility of this metal, prepared a series of samples of resublimated Mg in apparatus described in the article. Using this apparatus, the Mg contained only traces of chlorine. OWE (1)

Aluminum (Das Aluminium). E. Kuhn. *Dinglers Polytechnisches Journal,* Vol. 345, Mar. 1930, pages 41-43.

Metallurgy of Al; references and table compiling data on physical properties. EF (1)

Influence of the Elastic Stress State on the Magnitude of the Initial Permeability. (Über den Einfluss des elastischen Spannungszustandes auf die Grösse der Anfangspermeabilität.) M. Kersten. *Zeitschrift für technische Physik,* Vol. 12, Dec. 1931, pages 665-669.

The present paper directs attention to the correlation of the initial permeability of ferro-magnetic material to the thermal and mechanical pretreatment: the initial permeability can be increased by proper heat treatment and is cut down by mechanical stress such as rolling and drawing. With reference to Becker's interpretation of the technical magnetization curve, the initial permeability of a ferromagnetic body with large internal stresses is approximately computed. The theoretical derivations are checked by Ni wire which was elastically and plastically drawn. A theoretical relationship permitting the anticipation of the maximum value of initial permeability is satisfactorily confirmed by experiments on several Fe-Ni alloys. EF (1)

Optical Excitation Functions of Cadmium and Zinc Lines. (Die optischen Anregungsfunktionen der Kadmium- und Zinklinien.) K. Larché. *Physikalische Zeitschrift,* Vol. 32, Feb. 15, 1931, pages 180-181.

A paper before the Deutsche Physikalische Gesellschaft, Dresden, 1931, is summarized which refers to (a) the determination of the excitation function of 74 lines of Cd and Zn, and (b) measurements of the relative intensities of Cd and Zn lines and (c) the correlation of the slope of the intensity maxima to the life times of the lines investigated. EF (1)

Melting under Pressure and the Value of Interpolation Formulae (Ueber das Schmelzen unter Druck, zugleich ein Beitrag über den Wert von Interpolationsformeln). E. Jänecke (University of Heidelberg). *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 156, Sept. 1931, pages 161-175.

Plain equilateral hyperbolae, like $(p + a)\ (b - t) = c$ and some of a higher order as $(p + a)^r(b - t) = c$, correlate melting point to pressure fairly well according to experiments carried out. The melting point of metals and the conditions met with in the center parts of the earth are discussed in the conclusion. EF (1)

Some Experiments on the Strain-Hardening Induced in Iron and Steel by Certain Types of Mechanical Deformation, with Special Reference to D-Links for Colliery Tram Shackles. W. R. D. Jones & K. G. Lewis. *Proceedings, South Wales Institute of Engineers,* Vol. 47, Part 1, Sept. 15, 1931, pages 342-351, 399-406.

Discussion of article abstracted in *Metals & Alloys,* Vol. 2, Nov, 1931, page 241. AHE (1)

The Beryllium Molecule. W. H. Furry & J. H. Bartlett. *Physical Review,* Vol. 38, Jan. 1932, pages 210-225.

The interaction of a normal Be atom with one which has an electronic configuration 2s2p has been studied by means of the Heitler-London method. Of the eight possible molecular states, two are calculated to be stable. An attempt to obtain agreement with experiment in the case where a normal Li atom interacts with one in the $2p^2P$ state has not been successful. WAT (1)

Scattering of Hard Gamma Rays. L. H. Gray. *Proceedings Royal Society* (London), Vol. A 130, 1931, pages 524-541.

The relative scattering powers of Mg, Al, Cu, Zn, Cd, Sn and Pb for Ra C γ rays filtered through 4 cm. of Pb, and for Th C γ rays filtered through 3 cm. of Pb have been investigated by observing the ionization produced by radiation scattered within the angular range 10-30°. For Ra C γ rays the decrease of scattering power per extranuclear electron from Mg to Pb is 2%; for Th C γ rays there is a gradual increase of about the same amount, but this is of the order of magnitude of error in the application of the correction for reabsorption of scattered radiation in the scatterer. Therefore these measurements establish the fact that the binding forces in heavy elements do not influence appreciably the scattering power of extranuclear electrons for radiations of energy corresponding to 2×10^6 electron volts. WAT (1)

Photo-electric Effect and Electron Reflection on Hydrogenated Surfaces of Potassium. (Ueber lichtelektrische Wirkung und Elektronenbeugung an hydrierten Kaliumoberflächen.) W. Kluge & E. Rupp (Res. Inst. of Allgemeine Elektrizitäts Gesellschaft). *Physikalische Zeitschrift,* Vol. 32, Feb. 15, 1931, pages 163-172.

A testing method is described which is fitted for carrying out photo-electric measurements and investigations of interferences by means of reflected electrons on the same surface of the metallic sample. The electron reflection maximum led to a value 7.3 V for the inner potential of K and 5.4 A.U. for the lattice constant of KH. EF (1)

The Relative Permeability of Iron, Nickel, and Permalloy in High Frequency Electro-Magnetic Fields. Edwin Michael Guyer. *Journal of the Franklin Institute,* Vol. 213, Jan. 1932, pages 75-88.

Relative magnetic permeability of Fe, Ni, and permalloy measured over range of 70 to 200 meter wave-lengths by heterodyne balance and reasonance methods. Results showed that, when certain definite precautions were observed in making the measurements, nothing suggestive of anomalous dispersion of magnetic permeability in this wave-length region was found. When these precautions were neglected irregular breaks resulted in permeability curves as a function of wave-length which varied in position with conditions of the circuit. High frequency resistance of Fe, Ni, and permalloy wires was also measured over range of approximately 50,000 kilocycles from 2 to 3 meter wave-lengths. As before, when definite precautions were taken in measurements, no anomalous variations at certain frequencies were found to exist. Apparatus of various methods in full, together with graph of results. DTR (1)

Tantalum, the Long Elusive Metal. *Metal Progress,* Vol. 18, Dec. 1930, pages 50-53.

The history and properties of Ta, occurrence of its ore, methods of reduction, and uses of the metal are described. WLC (1)

On the Molecular Spectra of Mercury, Zinc, Cadmium, Magnesium and Thallium. H. Hamada. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, July 1931, pages 50-67.

Results of tests to determine the energy states and spectral excitation of diatomic molecules. It can be stated that a band system emitted from such molecules has 2 broad maxima and one flat minimum of intensity. One of the maxima always coincides with a resonance line; the other lies at the region of longer wave length and is generally connected with a coarse structure. Ha (1)

Recently Discovered Complexities in the Properties of Simple Substances. P. W. Bridgman (Harvard University). *Transactions American Institute Mining and Metallurgical Engineers,* General Volume 1931, pages 17-37.

Science lecture before A. I. M. E. meeting at Boston in Sept. 1931. Due to the extensive study of the atom, physicists have recently been inclined to neglect the study of matter in bulk. Surprisingly complex phenomena recently observed include (1) the so-called structure sensitive phenomena; (2) complexities of such a nature that they are masked by the presence of extraordinarily small amount of impurities; (3) complexities depending on internal molecular rearrangements which can be understood only from the view of the quantum theory. The faults, imperfections or cavities produced at regular intervals in a crystal lattice are discussed under (1). These faults divide the crystal into blocks of from 10^4 to 10^6 atoms each, and account for the low strength shown by matter. Work of Goetz on Bi crystals and Smekal on NaCl is discussed in some detail. Under (2) and (3), complexities observed chiefly at low temperatures or high pressures are treated. JLG (1)

Zinc and Its Alloys. *Bureau of Standards Circular* No. 395, 1931, 214 pages.

The physical and mechanical properties of Zn summarized from the technical literature, together with results obtained at the Bureau, are given. Special consideration has been paid to the effect of structural conditions of the metal resulting from impurities and from such factors as mechanical working, recrystallization, etc., upon the measured physical properties. The corrosion resistance of Zn, especially as related to its usefulness as a protective coating for steel, is discussed. The various alloy systems are summarized from the standpoint of constitution. Particular attention is given to the die-casting alloys and the properties which determine their usefulness industrially. A rather complete bibliography is included in the form of selected references appended to the various sections in which the different properties are discussed. The early history of Zn dating back to the year 500 B. C., is discussed. Many tables, charts, and diagrams illustrate the data presented. It is probably one of the most complete collections of data ever compiled on Zn and its alloys. WAT (1)

Rare Metals—1931 edition. Fansteel Products Co., N. Chicago, Illinois. 70 pages.

This interesting 70 page brochure differs from the 1929 edition in several points. Commercial Ta is now 99.9% pure instead of 99.8%, and costs 1/7 as much as Au instead of ¼. The temperature up to which Ta is not affected by O is revised downward to 400° C. Ta weights for laboratory balances are now available from supply houses. New products described are TaW metal, an alloy of Ta and W, tantalum carbide (Ramet) tools, wire drawing dies, and lapping powder, and metallic Cs and Rb. Smaller sizes of W, Mo and Ta wires are now available and the tables of wire data have been correspondingly augmented. It is stated that powdered Mo is being used in bronze to add resistance to abrasion and impact. The statement that a trace of Mo in iron retards the tendency to rust is also made and may be questioned, since the corrosion-resistant properties claimed for the product in question are supposed to be conferred by Cu; the Mo is added for other purposes. Straight Mo iron is not ordinarily reputed to be improved as to corrosion. On the whole, however, the information in the pamphlet appears essentially reliable, and it shows interesting advances in the production and use of rare metals. HWG (1)

Hydrogenized Iron. P. P. Cioffi. *Physical Review,* Vol. 38, Jan. 1932, pages 363-367.

The paper is one of those presented in the Symposium on Magnetization of the American Physical Society, Sept. 1931. Single crystals of iron grown by a new method with high temperature heat treatments in hydrogen were found to have better magnetic characteristics than single crystals grown at lower temperatures in hydrogen or in vacuum. Experiments show that the improved characteristics were not due to the large grain size but rather to the high temperature hydrogen treatment. It is now possible to produce iron having very high initial and maximum permeability regardless of grain size and orientation. WAT (1)

Beryllium and Aeronautical Construction. (Le glucinium et la construction aeronautique.) Leon Guillet & Marcel Ballay. *Revue de Metallurgie,* Vol. 28, Oct. 1931, pages 525-528.

Pure Be cannot be used for mechanical purposes because it is too brittle. It does not alloy easily with Mg, though claims were made that the Mg-Be alloys possess the strength of steel. It alloys easily with aluminum but the product is not superior to Al-Si alloys without heat treatment and, even in the heat treated condition, it is not superior to Al-Mg alloys. Quenching and aging of Cu-Be alloys, at 820° and 350° C. increases its Brinell hardness from 110 to 425, greatly diminishing the electrical resistance. Be acts in the same manner in Cu-Sn, Cu-Zn and Cu-Al alloys at least in those having a high Cu content. Brinell hardness of 350-400 is produced here by aging at 250°-350° C. Fe-Be alloys containing more than 2% Be are hardened by drawing at 520° C. after 1100° C. quench. The alloys are so coarsely crystalline that their practical usefulness is doubtful. Ni-Fe alloys to which Be is added are free from grain coarseness and, after quenching from 1100° C. followed by aging at 450° C., give a hardness of about 600 Brinell, though their C content may be very low. 1% of Be added to stainless Ni-Cr alloys hardens them in the same way after quenching at 950° C. and aging at 500° C. No data is given regarding the corrosion-resisting properties of these alloys after treatment. JDG (1)

Examination of Beryllium (Untersuchungen über Beryllium). Heinz Borchers. *Metallwirtschaft,* Vol. 10, Nov. 13, 1931, pages 863-866.

7 references. Be does not form a compound with H. It is not affected by dry or moist air or water. Be powder burns in air when ignited with a Mg ribbon, but a larger piece oxidizes on the surface when heated in O which retards further oxidation. Heated in air, it is covered with white oxide and nitride 300° C. below the melting point. At higher temperatures it has great affinity for even traces of O. Be does not combine with A, and is a suitable atmosphere for melting Be. Be readily forms a carbide, which reacts with SiO_2 at about 1400° C. and with Al_2O_3 when molten, forming BeO. BeO is not soluble in Be. 99.7% pure Be has a melting point of 1285° C. The impurities consisted of 0.28% Fe and 0.02% Al. Small quantities of C depress the melting point. At about 1500° C. and 5 mm. pressure, Be volatilizes at a fairly rapid rate. As the oxide and nitride volatilize at about the same temperatures complete purification of Be by distillation is not possible. Brinell hardness of electrolytic Be 280-300, remelted Be 145-150 and refined Be 140. Electrolytic Be is very brittle. Electrolytic Be contains, as impurities, mainly Fe, also Al, Si, Mg, C and gases. C can be removed by holding the metal for some time at 100° C. above its melting point, the carbides sinking to the bottom. Gases can be removed by melting in vacuum and Fe by distillation. Crucibles for melting consisted of MgO coated with BeO. CEM (1)

Photoelectric and Thermionic Emission from Cobalt. Alvin B. Cardwell. *Physical Review,* Vol. 38, Dec. 1931, pages 2033-2040.

The total photoelectric emission from a strip of Co foil excited by the undispersed radiation from a quartz arc was studied during an extended outgassing process and after stable conditions had been reached. The sensitivity rose quickly in the initial period, then decreased to a stable value. A change in the long-wave limit consistent with the change in the sensitivity was observed. Curves were plotted showing the variation of the full arc sensitivity with temperature. At a temperature near 850° C. abrupt changes in these curves were observed. X-ray analyses seemed to indicate that this resulted from a structural change. The long-wave limit for Co which had been cooled suddenly from above 850° C. and which was known by X-ray analysis to have a face-centered cubic structure was between 2967 A.U. and 3022 A.U. (4.25 ± 0.08 volts). A sample which was cooled slowly from above 850° C. and which was known from X-ray analysis to have a hexagonal close pack structure had a long-wave limit between 2757 A.U. and 2967 A.U. (4.12 ± 0.04 volts). A plot of the thermionic current as a function of temperature indicates that there is an abrupt change in the Richardson (A) or (b) and perhaps both at a temperature near 850° C. WAT (1)

The Surface Tension of Liquid Metals. Part IV. The Surface Tension of Mercury. L. L. Bircumshaw. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Aug. 1931, pages 596-602.

The surface tension of Hg has been determined by the method of maximum bubble pressure from 20° C. down to — 37° C. The surface tension seems to pass through a maximum at approximately — 33° C. Ha (1)

Investigations on the Electric Conductivity of Thin Metallic Layers. (Untersuchungen über die elektrische Leitfähigkeit dünner Metallschichten.) G. Braunsfurth. *Annalen der Physik,* Series 5, Vol. 9, 1931, No. 4, pages 385-418.

The specific resistance and the temperature coefficient of the electrical conductivity show irregularities for thin metal layers for which reasons the present investigation was made. The preparation of the thin layers and the methods of testing are described and a theory on the influence of the thickness of the layer is developed on the basis of the test results; a formula expressing this is developed. For the rare metals Pt, Sr, Rh, the absolute thickness of the anomalous layer lies between 2×10^{-8} and 1×10^{-7} cm; for thinner layers, peculiar discontinuity points in the curves occur, due probably to a loosening of the structure. The temperature coefficient decreases with increasing specific resistance. Ha (1)

Theory of the Magnetization Curve of Ferro-magnetic Single Crystals. (Zur Theorie der Magnetisierungskurve ferromagnetischer Einkristalle.) F. Bloch. *Physikalische Zeitschrift,* Vol. 32, Apr. 1, 1931, page 290.

Briefly refers to a paper at the Deutsche Physikalische Gesellschaft, Dresden, 1931, and deals largely with the measurements of Kaya on ferro-magnetic single crystals. (1)

The Photoelectric Properties of Tantalum. Alvin B. Cardwell. *Physical Review,* Vol. 38, Dec. 1931, pages 2041-2048.

Ta was carefully outgassed and its photoelectric properties studied after stable conditions were reached. Heating 1000 hrs. at temperatures up to 2200° K. produced an apparent stable condition of the surface. Curves, showing the variation of the photoelectric current as a function of the temperature, are plotted for different wave-lengths. For wave-lengths near the threshold, there is a great increase in the photoemission with increasing temperature. With decreasing wave-lengths, this variation becomes very much smaller. Extrapolated values from the F (λ) curves show the long-wave limit to be at 20° C., 2750 A.U.; and at 700° C., 2825 A.U. Further heat treatment at temperatures up to 2500° K. produced a final stable condition. Here again are plotted curves showing the variation of the photoelectric current as a function of the temperature for different wave-lengths. In this case, the great increase in the photoelectric sensitivity with temperature for wave-lengths near the threshold becomes smaller as the wave-lengths used decrease, finally reaching negative values for wave-lengths more than 300 A.U. shorter than the threshold value. Extrapolated values from F (λ) curves at 293° K. and 973° K. show the long-wave limit at the respective temperatures to be 3050 A.U. and 3160 A.U. From curves plotted according to Fowler's theory, the true threshold wave-lengths were found to be as follows: (1) for Ta in first apparent stable condition (average) = 2742 A.U. (4.50 volts). For Ta in final stable condition (average) = 2974 A.U. (4.15 volts). WAT (1)

PROPERTIES OF FERROUS ALLOYS (3)

The Physical Properties of Manganese Sulphide with Relation to its Effects in Steel. EDWARD C. KREKEL. *Colorado School of Mines Quarterly,* Vol. 25, Oct. 1931, 30 pages.

The publication is a thesis and is a tribute to the memory of the author, who died suddenly Aug. 10, 1926. The melting point of manganese sulphide is very high, at least well above 1600° C. Manganese reacts with iron sulphide to form manganese sulphide and iron. The reversibility of this reaction has not been verified. Manganese sulphide and iron form a eutectic mixture. It is probably this eutectic which is the substance commonly mistaken for manganese sulphide in steel. The compound $Fe_3Mn_2S_5$ as formulated by Rohl very possibly exists, but it is unlikely that this is the substance which occurs in steel. The preparation of manganese sulphide is described and the conclusions are illustrated with a number of micrographs. WAT (3)

Fe-Mn-Ni-C, a New Manganese Steel. JOHN HOWE HALL (Taylor-Wharton Iron & Steel Co.). *Metal Progress,* Vol. 20, Nov. 1931, pages 69-72.

A modification of Hadfield's manganese steel with 3½% Ni and approximately eutectoid C content is described and its properties discussed. The ease of working and the weldability of this new alloy are stressed. WLC (3)

Several Grades and Uses of Bessemer Steel. Correspondence from B. GRINDAY, Youngstown, Ohio. *Metal Progress,* Vol. 21, Jan. 1932, pages 70-71.

The writer directs attention to some neglected possibilities of Bessemer steel which has greater ductility, better machining qualities and wider range of analysis than is generally realized. WLC (3)

The Hadfield Manganese Steel; Its Structure and Properties (Der Hadfield-Manganstahl; sein Gefüge und seine Eigenschaften). G. GUZZONI. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 6, 1931, page 868.

The structural conditions of this steel are examined. With very rapid cooling, a complete austenitic structure is possible. When annealed, the austenite is converted directly into troostite. At the same time, hardness and brittleness increase and magnetism is restored. The important factors for the formation of the structure were determined. The austenitic structure is closely related to the best properties of the Hadfield Mn steel. Its principal quality is the high resistance to wear. The Brinell hardness is 500. Ha (3)

The Strength of Cast Iron in Relation to Thickness. P. A. HELLER. *Foundry Trade Journal,* Vol. 45, Oct. 15, 1931, page 243.

Extended abstract of article which appeared in *Die Giesserei* (1931, Vol. 18, pp. 237-241). It is accompanied by 3 diagrams. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 3. OWE (3)

Austenitic Cast Iron. J. E. HURST. *Foundry Trade Journal,* Vol. 45, Oct. 15, 1931, pages 237-239.

The author describes the properties of a 15% Ni-7% Cu austenitic iron cast by the centrifugal process and containing varying quantities of Cr. Increasing quantities of Cr hardened the material, the ultimate strength and modulus of elasticity being increased. The stress at which substantial permanent set is taken up is raised, but the magnitude of the permanent set is lowered. The effect of initial stress tends to increase the stiffness, raise the limit of proportionality, and decrease the liability to subsequent permanent set and deflection. The strength properties are satisfactory in alloys containing up to 4.21% Cr. The iron becomes unmachinable at 7% Cr. Heat treatment has very little effect on the Brinell hardness of these alloys but the strength properties are generally improved, the improvement increasing as the Cr content of the iron increases. Quenching definitely increases the ductility of the high-chromium materials. The coefficient of expansion of an alloy containing 15.13% Ni, 6.95% Cu, 2.75% Cr, over a temperature range of 650° C., was found to be 1.89×10^6. The alloys possess good corrosion- and heat-resisting properties. The article is accompanied by 3 tables and 7 figures. OWE (3)

Iron-Tungsten-Carbon System. Correspondence from K. HONDA, Sendai, Japan. *Metal Progress,* Vol. 20, Dec. 1931, pages 75, 83, 99.

The writer reports on a study by Shuzo Takeda on Fe-W-C system. Equilibrium diagram is reproduced on page 75. WLC (3)

The Manufacture and Testing of Forging Quality Steel. NORMAN L. DEUBLE. *Iron & Steel of Canada,* Vol. 14, Dec. 1931, pages 179-181, 190.

Article, accompanied by 6 macrographs, reprinted from the Sept. 1931 issue of *Heat Treating & Forging.* See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 3. OWE (3)

Tests Indicate Thick Steel Plates Meet Specification. F. O. DUFOUR. *Engineering News Record,* Vol. 107, Oct. 29, 1931, pages 689-690.

Results from about 2 doz. coupons from 2 1/16 in. plate rolled from a single ingot show uniform yield point and ultimate strength varying from 53,800 lbs./in.^{2} at the bottom to 60,800 lbs./in.^{2} at the top of the plate. The variation is due to a segregation of non-ferrous elements in the top part of the ingot. This segregation is accompanied by a variation in physical properties: from the bottom to the top of the plate, with increasing percentages of C, Mn, P and S; there is, likewise, an increase in the yield point and the tensile strength and a decrease in ductility. These relations are shown in tables. Ha (3)

The Valuation of Cast-Iron According to Brinell Hardness. (Die Bewertung des Gusseisens nach der Brinellhärte.) CHR. GILLES. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 27, 1931, pages 894-898.

A further discussion of the relation of rating of cast-iron according to hardness to wall thickness again leads to the conclusion that the Brinell hardness permits only a limited measure for strength and the resistance to wear of cast iron; it is of a certain value only in the case of a pearlitic structure with a very fine distribution of graphite. But it is very difficult to produce such structure. The founder generally knows by experience what kind of a cast iron he has to supply for the dimensions of the piece in question. Ha (3)

Stainless Iron and Steel. J. H. G. MONYPENNY. Second Edition. John Wiley & Sons, Inc., New York, 1931, Cloth, 6 x 9¾ inches, 575 pages. Price $7.00.

The first edition of this book, published 5 years ago, was exhausted in 2 years. Not only the increased size of the book but also the greater clarity with which the reasons for the behavior of the steels are discussed, bear witness to the recent rate of progress in the knowledge of the chromium and chromium-nickel steels.

The treatment is very complete. In discussion of heat treatment, corrosion, and high temperature properties, for example, the reader's memory is refreshed on the general theory before the specific case of stainless steel is dealt with. The work of metallurgists in many countries is culled and all available information is brought in to supplement the author's own wide experience in this field. The result is an extremely useful monograph. It will be the first book to look in for information on these alloys and its existence will save time that would otherwise have to be spent in going through the very extensive literature of the subject.

The advantages of these steels are of course prominently set forth, but the disadvantages and difficulties are equally frankly given. It is written in the scientific vein.

The information is confined to wrought steels, data on cast steels being rather conspicuously absent, which seems odd in so comprehensive a monograph.

The structure and mechanical properties of the plain chromium steels are dealt with first, then the effect of nickel and that of other alloying elements in both the plain Cr and the Cr Ni types. The effect of variations in composition and heat-treatment, corrosion resistance, high temperature resistance, and manufacture and working are discussed from the point of view of the whole group of steels.

Some of Monypenny's specific comments are particularly interesting. He points out that acid "corrosion tests" for material to be subjected to other corrosive media or to atmospheric exposure are very likely to lead to erroneous conclusions. The claim that 0.07% C is a limiting value below which intergranular brittleness is avoided in the 18-8 type, is denied, and 0.03% given as a more probable value. The addition of W, Ti, or V, may retard, but does not eliminate carbide precipitation. Mention is made of the addition of Si plus a heat-treatment designed to precipitate the carbide deliberately, which may be effective.

The utility of short-time high-temperature tensile tests, as a preliminary to creep testing, is emphasized. Monypenny is not enthusiastic about Hatfield's "time-yield" test, pointing out that the rate of creep does not become constant in the time allowed in the Hatfield test, and that the indication of the time-yield data in respect to 18-8 are at variance with reliable creep data. The discrepancies in creep data themselves obtained by various investigators are greatly smoothed out if the data for alloy steels are referred to each investigator's own data for mild steel, and since engineers are acquainted with the service behavior of mild steel at high temperatures, they can appraise the real possibilities of the alloy steels in service quite accurately by comparison.

In discussion of properties after long exposure to elevated temperatures, it is stated that some Ni Cr Mo steels that appear free from temper-brittleness on short-time tests, show it after several months at 400°-450° C.

Although the thermal conductivity of the stainless steels is low, in most cases where heat-transmission is involved other thermal resistances than that of the metal parts themselves are the controlling factors, so that low conductivity is seldom a real drawback.

Even the metallurgists not especially interested in stainless steels will find the book of much value from the general metallurgical viewpoint. Those who are interested will find it indispensable. H. W. Gillett (3)-B-

Steel and its Heat Treatment for Parts that must Resist Wear. H. W. MCQUAID. *Heat Treating & Forging,* Vol. 16, Sept. 1930, pages 1159-1162, 1164.

Discussion of the relative status and economy of the different steels and treatments which can be used where a hard surface is required; some classifications according to their relative costs. The grain size has an important bearing on the machining properties and distortion in heat treatment. This should be taken into account when specifications are made for a certain purpose. Ha (3)

High Carbon, High Chromium Stainless. H. T. MORTON & I. A. RUMMLER. (Hoover Steel Ball Co.) *Metal Progress,* Vol. 21, Feb. 1932, pages 49-52.

The authors present a study of 1.0% C and 17.0% Cr stainless steel for valve parts used in oil lines. Forging must be done in the range 1850-2200° F., followed by normalizing from 1600° F. Shearing, if any, must be done hot, 1900-2100° F. This steel absorbs heat slowly and care must be exercised in all heating operations to be certain of complete and uniform heating of the material. Slow solution of the Cr carbides makes a temperature of 400° F. above the critical necessary in the hardening of the alloy. Full hardness of 59-63 C Rockwell is obtained by quenching from 1900-1925° F. After tempering up to 800° F. cooling may be slow or rapid above 1100° F. it should be followed by quenching. Range 825°-1075° F. should be avoided for drawing, as a brittle condition results. Charts of properties and micrographs illustrate the paper. WLC (3)

Further Data Required on Tough-Hardness of Steel. E. F. LAKE. *Steel,* Vol. 88, Mar. 26, 1931, pages 42-44.

The usual physical tests do not give a correct view on the tough-hardness of a steel; impact tests seem to be the best to judge toughness. Steels for moving parts show usually best results when hardened correctly and drawn at temperatures between 700° and 800° F. Cr-Ni alloys show the necessary properties to the best degree. Ha (3)

The Development of Alloy Steels. C. E. MACQUIGG. *Mining & Metallurgy,* Vol. 11, Dec. 1930, pages 578-580; *Heat Treating & Forging,* Vol. 17, Feb. 1931, pages 151-152, 154.

A brief outline of the views of the present and the past concerning the composition and use of alloy steels. Ha (3)

The Manufacture of High-Grade Castings in the Brackelsberg Rotary Furnace. PETER M. MACNAIR. *Foundry Trade Journal*, Vol. 45, Dec. 17, 1931, pages 377-381.

A description of the methods adopted for obtaining low C iron by means of the Brackelsberg rotary furnace, together with a description of the mechanical properties obtained. The article is accompanied by 3 tables, one of which gives particulars of the relative melting costs of iron produced in the cupola and in the Brackelsberg furnace. The following advantages for the Brackelsberg furnace are summarized: (1) Low C content, giving fine graphite distribution with good tensile and shock properties with ease of machinability; (2) freedom from nuclei, giving fine graphite distribution and a small grain size, thus giving superior mechanical properties; (3) control of Si, S, P and Mn, giving any type of desired metal; (4) sound castings, giving superior mechanical properties and reducing wasters; (5) homogeneous metal, giving same composition throughout castings; (6) ease of adjusting composition of metal, if required, before casting; (7) hot metal, giving sufficient fluidity to cast very thin sections; (8) suited for manufacture of alloy cast irons, giving homogeneous metal with minimum oxidation losses of expensive alloying elements; (9) low C, fluid metal, suitable for malleablizing by the whiteheart or blackheart process. OWE (3)

The Upper and Lower Yield Points of Structural Steel (Om övre och undre sträckgräns hos byggnadsjärn). AXEL LUNDGREN with additions by ARVID JOHANSSON & G. MALMBERG. *Jernkontorets Annaler*, Vol. 114, Oct. 1931, pages 493-544.

When the stress is continually increased up to a certain point (the upper yield point), within the yield range of the load-extension diagram, it generally falls down to a certain lower value. The lowest stress obtained within the yield range is called the lower yield point. A Swedish Government Committee recently proposed the insertion of specifications concerning the yield point for structural steel, and the experiments were undertaken to determine the influence of test piece dimensions and traction velocities in order to arrive at a rational basis for the proposed specifications. No marked relation was found between the dimensions and the load extension diagram, but plate materials gave very little difference between the upper and lower limits, and the round test pieces gave irregular results. The relation between the breaking limit B and the upper yield limit S_o and lower limit S_u varies from $\frac{S_o}{B} = 61\% - 72\%$ and $\frac{S_u}{B} = 51\% - 61\%$. For a steel containing 0.10% C the breaking strength of 22 kg./mm.[2] is recommended and for a steel of 0.25% C 26 kg./mm.[2]; a tolerance of 5% is allowed. Traction velocities corresponding to an increase of stress of less than 30 kg./mm.[2] gave consistent results. The best strength is obtained when the steel is finished at 400°-500° C. HCD (3)

The Influence of Pickling and Zinc Coating on the Tensile Properties of Drawn Steel Wire (Der Einfluss des Beizens und Verzinkens auf die Festigkeitseigenschaften von gezogenem Stahldraht). H. VAN DE LOO, W. PÜNGEL & E. H. SCHULZ. *Stahl und Eisen*, Vol. 51, Dec. 24, 1931, pages 1585-1590; *Mitteilungen Forschungs-Institut der Vereinigten Stahlwerke*, Vol. 2, 1931, Report 7, pages 113-148.

9 wire ropes of the same C content and the same diameter were drawn with different force and subjected to pickling tests, tempering tests and galvanizing tests in order to determine the effect of these treatments on the properties of the finished galvanized wire. The results can be summarized briefly. (1) Pickling tests. HCl produces, in all concentrations, considerably less brittleness than H_2SO_4; with HCl, only a decrease in the number of bendings and twistings is noted, while the H_2SO_4, tensile strength, elongation, bending and twisting are reduced; the latter 2, very greatly. The content of C seems to enhance the decrease of bendings, but to impede that of the torsions. Pickling brittleness can be completely eliminated with HCl. After pickling with H_2SO_4, weakly drawn wires recover least. Pickling brittleness can be removed by annealing but the temperatures required have a great influence also on non-pickled wires. Short annealing at between 400° and 500° C. in lead removes the brittleness entirely after pickling with HCl but not with H_2SO_4. (2) Tempering tests in lead and galvanizing. Tempering reduced the strength and increased the elongation in all wires; this increases with annealing temperature and annealing time. Bending and twisting numbers are decreased by tempering. A change of temperature and duration does not exert any influence on the bending number. All properties deteriorate with increasing C content and increasing degree of stretching with the exception of twisting, where the influences could not be clearly defined. Galvanizing exerts, with regard to tensile strength, elongation and springiness, the same influence as tempering. Bending and twisting deteriorate more than by tempering. The decrease is smaller, the more the wire is stretched. The number of bendings is practically independent of temperature, time and C content. The twisting number decreases with increasing temperature and duration and the less, the higher the C content. Examinations of the structure of the layer of zinc did not reveal any influence on the properties of the wire; but with higher temperature a uniform $FeZn_7$ layer could be detected. The practical conclusion is that wire for galvanizing should be pickled in hydrochloric acid. The slight brittleness occurring hereby is eliminated again completely by the heating in the galvanizing process. If pickling is done with sulphuric acid, only strongly drawn wires should be used because they, too, lose the brittleness. In order to obtain satisfactory bending and twisting values, it is advisable to draw down as much as possible a wire which is to be galvanized; a high C content is favorable. The familiar experience of galvanizing as quickly as possible and at low temperature is again confirmed by the tests. All individual tests and test results are thoroughly discussed. 44 references. Ha+GN (3)

Symposium on Malleable Iron Castings. C. L. WARWICK. *Proceedings American Society for Testing Materials.* Vol. 31, Pt. 2, 1931, pages 317-387.

Summary prepared by a special committee of the American Foundrymen's Association and the American Society for Testing Materials. Includes discussion. Uses, manufacture and properties of malleable are discussed. Supplementary data shows variations in properties and effect of various factors on strength. Higher strength malleable and cupola malleable are briefly described. Factors in design of patterns for malleable castings are discussed and a résumé of current specifications for malleable is given. The whole symposium has been summarized by Schwartz in *Metals & Alloys*, Vol. 2, Sept. 1931, pages 143-149. In discussion Kelly objected to the statement of the committee that embrittlement of malleable in galvanizing could be prevented by control of chemical composition. Wolf and Meisse said this could be done only by holding P below 0.15% and Si below 0.80%, which is not the case in normal malleable. They also suggested that the average physical properties tabulated by the committee were higher than those of the average malleable if all producers were considered. HWG (3)

Hardness and Wear-Resistance of Piston-Rings and Cylinders (Härte und Verschleissfestigkeit von Kolbenringen und Zylinder). H. LEMKEN. *Deutsche Motorzeitschrift*, Vol. 8, June 1931, pages 366-368.

The author states that hardness alone does not represent the significant criterion for the wear resistance of piston rings and draws attention to American experience. Among various factors, the significance of the micro-structure is stressed. Includes 4 micro-photographs. EF (3)

Comparative Investigations on Lancashire Iron and Low Carbon Steel (Jämförande undersökningar mellam lancashirejärn och kolfattigt stal). TORKEL BERGLUND & ARVID JOHANSSON. *Jernkontorets Annaler*, Vol. 115, Sept. 1931, pages 409-484.

Mechanical, magnetic and electrical resistance tests were made on several low C steels, such as Swedish Lancashire, Lancashire with pig Fe charge, soft steel made in the electric furnace, Flodin Fe, and English and American Armco Fe. Tensile and impact tests were made on hot rolled material and bending tests and Erichsen deep drawing tests on sheets subjected to varying degrees of cold-rolling. The magnetic properties of both cold and hot-rolled materials were studied, while the electrical resistance was measured on cold drawn wire. No decided differences were noted, though the Lancashire iron seemed more uniform than those of extra low C content. The anti-magnetic properties are decidedly better; the coercive force shows very small increase on aging. The value of this property is about twice as great for Armco Fe after aging as for Lancashire Fe. Fe prepared in the C arc shows very erratic properties, possibly because the impurities are not very readily controlled. The Flodin Fe shows a low stretching limit compared to the breaking limit, which is quite similar to the Armco Fe. 11 tables and 75 figures contain the extensive numerical and photographic data. HCD (3)

The Wear of Cast Iron. *Bulletin of the British Cast Iron Research Association*, Vol. 3, July 1931, pages 10-13.

A résumé of the present situation regarding the wear of cast iron. The question continues to occupy the attention of metallurgists and engineers, particularly in the automobile industry, where the higher speeds and greater mileage now prevailing demand that the wear of cylinders and pistons be at a minimum. In addition, modern production methods demand castings that can be easily machined on mass production lines. The Association has set up a simple wear testing machine for carrying out tests under sliding friction and a number of types of iron have been investigated. The difficulty with the wear test, however, is that it is almost impossible to reproduce service conditions in the laboratory test if the results are to be obtained in a reasonably short time. The question of lubrication and local conditions must also play an important part in wear, and many instances of unusually rapid wear are found on investigation to be due to conditions other than the composition and structure of the metal in question. A very popular test for the wear of cast iron is one in which the specimen to be tested is pressed at constant load against a rotating drum made of a standard steel or cast iron. The test may be either lubricated or not and is measured by the loss of weight or depth of wear in a given time or number of revolutions, irrespective of the wear of the steel drum. Tests indicate that a pearlitic condition is most favorable for wear resistance. Additions of Ni and Cr produce more uniform wear at a lower rate than unalloyed castings. Many opinions have been put forward regarding the influence of P on wear. It has been held that the network formation of the phosphide eutectic in good engineering irons result in a bearing metal type of wearing surface in which the hard phosphide network stands out in relief and the softer matrix wears away and with the particles of graphite forms a lubricant. No definite relation can be obtained between wear and Brinell hardness beyond the tendency for harder (pearlitic) irons to give better wearing properties than softer (ferritic) irons. The wear of the softer irons when tested against the same material has been found to be about 8% higher than the harder irons, indicating some connection between hardness and wear. Best resistance to wear seems to be obtained when both moving parts are made of the same material. It would appear that a useful line of research would be the testing of cast iron against a similar cast iron under conditions which enabled the wear of both specimens to be measured. The surface conditions of the specimens before testing could be varied by processes of machining, grinding, lapping, etc., and the results may throw some light on the nature and mechanism of formation of the "glazed" surface which is a feature of cast iron wearing parts. WAT (3)

High-Silicon Pig Iron for the Production of Malleable Iron (Hochsiliziumhaltiges Roheisen zur Herstellung von schmiedbarem Guss). A. L. BOEGEHOLD & C. JOSEPH. *Die Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 6, 1931, page 868.

The irregularities in the physical properties of malleable iron are investigated. The influence of Sn, V, Cr, Ti, P, O and N are examined, but no positive results were obtained. Ha (3)

Ferromagnetism and Electric Properties. II. Explanation of the Increase of Magnetic Resistance of Ferro-magnetic Conductors of Electrons. (Ferromagnetismus und elektrische Eigenschaften II. Die Deutung der magnetischen Widerstanderhöhung ferromagnetischer Elektronenleiter.) WALTER GERLACH. *Annalen der Physik*, Series 5, Vol. 8, 1931, No. 6, pages 649-662.

The increase of the longitudinal magnetic resistance of ferro-magnetic bodies at constant temperature, at different temperatures and after previous magnetization can be accurately represented by a formula containing the square of the magnetization; the increase starts only above a critical magnetization which is the component of the magnetization in the direction of the magnetic field. Ha (3)

Note on Melting of Electric Furnace Cast Iron for Rolling Mill Rolls (Note sulla fusione di cilindri di ghisa per laminatoi al forno elettrico). L. DELGROSSO. *La Metallurgia Italiana*, Vol. 23, Dec. 1931, pages 1127-1134.

A 15-ton Heroult furnace using Soderberg electrodes melts 12 tons of pearlitic high test iron in 3-4 hrs., at 700 k.w.h/metric ton. The metal is cast at 1250°-1280° C. Loss of Mn and Si is only 10% against 30 to 50% in a reverberatory furnace. The graphite flakes are smaller and more uniformly distributed in the electric furnace iron. Analyses of a dozen heats from the electric and a dozen from the reverberatory are given. The range was total carbon—electric 2.21-2.52%, reverberatory 2.25-2.60%; combined carbon 0.65-0.75%, 0.63-0.75%; Mn, 0.55-1.01%, 0.70-1.21%; Si, 0.96-1.25%, 0.85-1.30%; P, 0.32-0.42%, 0.30-0.40%; S, 0.02% or less, 0.05-0.08%. The chief difference in composition is the lower S content of the electric iron. Test specimens taken from the gates of the roll castings ran 27,000 to 34,000 lbs./in.^{2} tensile for electric and 23,000 to 29,000 for reverberatory iron. Transverse test on 30 mm. diameter 650 mm. bars tested on 600 mm. centers gave 35 to 44 kg./mm.^{2}, 6 to 9 mm. deflection for electric, and 28 to 36 with 3 to 5 deflection for reverberatory. Brinell hardness on the rolls fell off less in the interior of the roll in the electric iron. In service, the electric furnace rolls were used on an average tonnage of 192/mo., the reverberatory on 178, the wear/mo. was 5 to 8 mm. reduction in diameter on the electric and 7-10 on the reverberatory, the electric averaging 11 mos. service against 9 for the reverberatory. Includes 7 figures. HWG (3)

Characteristics of Alloy Steels. I and II. GEO. M. ENOS. *Modern Machine Shop*, Vol. 4, Dec. 1931, pages 9-14; Jan. 1932, pages 14-18, 22-23.

The characteristics as expressed in equilibrium diagrams are explained. Properties and uses of alloy steels and the alloying elements are discussed and the classification by the S. A. E. system is explained. A table showing the ranges of compositions of some alloy steels suitable for dies and tools is added. The effects of alloying elements are explained by diagrams illustrating the structures of simple alloy steels in the fully annealed condition. The particular high-speed steel alloys with Ni, Cr, W, Mo, and the percentages present are discussed and the heat treatment described. Micrographs illustrate the various degrees of hardness. Ha (3)

Cast Iron Today. A. B. EVEREST (Mond Nickel Co., Ltd.). *Welding Journal*, Vol. 28, Mar. 1931, pages 80-83; Apr. 1931, pages 102-109.

Paper before the Institution of Welding Engineers. The nature of cast iron is discussed, together with the influence of the cooling rate and composition. The limitations resulting from varying sections in a casting are outlined, i.e., difference in hardness in thick and thin sections and porosity and openness of grain. Part II. Includes discussion. The development of the use of special irons is discussed, referring first to work on the control of the nature of the carbon and the control of the rate of cooling. The author treats the use of alloys by showing the specific results brought about by Ni, Cr, Cu, Al, Mo, P, and S. AWM (3)

Mechanical Properties of Forged and Cast Steel with High Manganese Content. (Mechanische Eigenschaften von geschmiedetem und gegossenem Stahl mit hohem Mangangehalt.) P. BARDENHEUER & G. SCHITZKOWSKI. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung*, Vol. 13, Report 191, 1931, pages 237-245; *Stahl und Eisen*, Vol. 51, Dec. 17, 1931, page 1575.

The paper gives the results of the investigation of the mechanical properties of steels, containing 0.15-0.4% C and 0.9-3.0% Mn, which were tested in forged and cast state after various heat treatments. The properties were determined at temperatures between —20 to +100° C. In accordance with foreign investigations it was found that Mn contents up to 2% favorably affect the mechanical properties. The high Mn steel is distinguished by a high toughness and high tensile strength. The best properties are found in the forged as well as the cast steel, which contains 0.15-0.30% C. and 1.7 to 1.9% Mn. These steels gave after annealing at 900° C. for 5 hrs., air cooling, repeated annealing at 680° to 710° C. and subsequent slow cooling to room temperature in the furnace the best properties, as given in the following table:

State of Material	Yield Point lbs./in.^{2}	Tensile Strength lbs./in.^{2}	Elongation %	Reduction of Area %	Notch Toughness mkg./cm.^{2}
Forged	49800-64000	85300-99900	25-30	39-69	21-25
Cast	43300-43500	71900-85300	24-26	49-50	12-18

When the Mn content surpasses 2%, the properties, in particular the toughness, decrease the more the higher the carbon content is, and machining becomes difficult. This effect is more pronounced in the cast steel than in the forged steel. In the temperature range —20° to +100° C. the properties are not essentially affected by the temperature. Yield point and tensile strength slowly decrease with increasing temperature. In the forged steel elongation and reduction of area practically show no change, in the cast steel they slowly increase with the temperature. The notch toughness of neither one of the 2 steels shows a distinct dependence upon the temperature. Most of the properties of structural steels with 0.15-0.3% C and 1.7-1.9% Mn are similar to those of the structural Ni and Cr-Ni steels, so that in some cases they may be used instead of these steels. As cast steel this material can, after a suitable heat treatment, be used for the formerly used Ni-Cr alloyed steels. 13 references. GN (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Under-water Corrosion of Copper-Bearing Steels (Ueber die Unterwasserkorrosion des gekupferten Stahls). H. CASSEL & F. TÖDT. *Metallwirtschaft*, Vol. 10, Dec. 11, 1931, pages 936-937.

Contains 3 references. Recent literature on the behavior of copper-bearing steel when completely immersed in water, is discussed; it is somewhat contradictory. The resistance to corrosion of copper-bearing steel is analogous to that of copper plated steel. As the copper layer is porous in both cases it does not provide much resistance to corrosion and the addition of copper to steel for under-water use is purposeless. CEM (4)

The Formation of Boiler Scale. *Engineering*, Vol. 131, Jan. 30, 1931, pages 145-146.

Editorial commenting on work of Everett P. Partridge published as *Engineering Research Bulletin* No. 15 *of the University of Michigan*. LFM (4)

Corrosion Resistance of Aircraft Cables With Different End Connections. *Aviation Engineering*, Vol. 5, Dec. 1931, pages 36-38.

The official report of the Deutsche Versuchsanstalt für Luftfahrt describes a very complete investigation on the corrosion resistance of aircraft cables with different end connections. 3 types of wire were used: (1) a steel wire coated with pure Zn by the hot process, as customarily applied for the manufacture of standard aircraft cable; (2) a steel wire coated with pure Cd by the Udylite process; (3) a stainless V2Z-steel wire furnished by Krupp. 3 types of connections were used, sleeve fittings, splices and soldered splices. The sleeve fitting when finished looked very much like the "Tru-Loc-Fitting" of the American Cable Company. Splices were made in the usual way with thimbles. The soldered splices were also made with thimbles, the 2 ends merely being soldered together. This last type of connection is used almost exclusively by the German aircraft manufacturers. It requires considerable skill and experience to manufacture, but is 100% efficient in strength. The splice connection without the solder is from 10-30% lower in strength than the strength of the cable. 4 months of exposure to a salt water spray fog attacked the Cd coated cables less than the Zn coated ones. The stainless steel cables were very resistant to this attack, but do not prove satisfactory when attacked by concentrated hydrochloric acid as is used for making soldered terminals. Zn coated cables with sleeve end connections show 100% cable strength. The bare stainless steel wires are too hard for this process and should be galvanized at the ends prior to applying the fittings. Cd coated wires are too soft to hold the fittings; the Cd should be removed before the fitting is put on with galvanizing substituted at the points of contact. The corrosion resistance of the sleeve fitting is very high. In soldered splices, the hydrochloric acid necessary for the soldering operation, is very likely to promote corrosion, both in the Zn and the Cd coatings. WAT (4)

Data on the Resistance of Metals Suitable for Dies to the Abrasive Action of Plastic Clay. *Glass Industry*, Vol. 12, June 1931, page 127.

The object of the investigation, carried out at the Bureau of Standards, is to obtain data on the relative "wear values" of metals when subjected to abrasion by the continuous flow of plastic clay, such as occurs in dies for molding stiff mud clay columns. The abrasive material is a mixture of 60 parts of plastic clay and 40 parts of silica sand. 15% of water is added and the mass is tempered to a "stiff mud" condition. The volume of the plastic clay-sand mixture extruded through the orifice of the die specimen is constant for all tests and is extruded at a constant volume rate. The extrusion pressures cannot be governed closely inasmuch as they vary over a comparatively wide range for slight changes in the moisture content of the sand-clay mixture. A small decrease in moisture content causes a large increase in extrusion pressure. As the extrusion pressure increases, the wear loss also increases. It was, therefore, necessary to determine the relation between abrasion loss of the specimen and the extrusion pressure so that the comparative wear values could be determined for the different metals and alloys tested. Preliminary tests indicated that the abrasion loss and the extrusion pressure were directly proportional. Later data, however, indicated that the relation is parabolic according to the equation:

$$y^2 = \frac{CX}{K^2}$$

in which:

y = the abrasion loss of the specimen.
X = the extrusion pressure.
C = a constant.
K = the relative "wear value" of the material.

In the following table are given the relative K values, each representing the average of 8 tests. These values are calculated on a basis of unity for the material showing the least resistance to abrasion and represent the relative lengths of clay columns that can be extruded from dies of these materials which will produce the same amount of abrasion loss in each case.

	K
Zinc manganese bronze	1.00
Electrolytic copper	1.72
Rustless steel	7.09
Soft cast iron	7.91
Steel alloy (soft)	8.25
Steel alloy (hard)	8.41
Medium cast iron	9.00
Hard cast iron	9.36
High C steel (hardened)	19.56
Co-Cr-Mo steel (cast)	127.90
Co-Cr-Mo steel (rolled)	148.58
Co-Cr-W steel	334.35

4 tests in duplicate were also made on a sample of nitrided steel. The comparative wear value K for successive tests were 33.61, 26.84, 21.24, 14.50, which indicated decreasing resistance to abrasion as successive layers of the "case hardened" steel were removed. WAT (4)

Review of the Behavior of Aluminum Against Materials of the Chemical and Foodstuff Industries. (Uebersicht über das Verhalten des Aluminiums gegenüber Stoffen der chemischen und der Nahrungsmittel-Industrie.) Compiled by H. BOHNER, H. BUSCHLINGER & H. ROEHRIG. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk*, Vol. 3, Sept.-Nov. 1931, pages 301-346.

A very complete compilation of data and experimental results of the resistance of Al and light-metal alloys against organic and inorganic matters, with numerous illustrations of apparatus, tanks, machinery, etc. used in these two industries. Ha (4)

Protection of Pipes against External Corrosion. *Gas Age-Record*, Vol. 66, Dec. 13, 1930, pages 937-939.

Corrosion of Pipes Sub-Committee Report before the Institution of Gas Engineers, Nov. 1930, London, England. External corrosion may be due to contact corrosion of the soil or to stray electric currents and may be prevented by preventing water coming in contact with the metal or by applying a reverse electromotive force so that the metal is either neutral or cathodic. This investigation was concerned only with the prevention of water reaching the metal. 2 methods were used to determine the permeability of protective coatings to water. One, as used by the Gas Light & Coke Co., depends upon a measurement from time to time of the effective electrical resistance of the protective coatings applied to the pipe and immersed in water or solution. This method affords useful information regarding the course of the penetration of water, etc., because, with increasing depth of penetration, the electrical resistance of the protective coating will generally decrease until it reaches a constant value indicating penetration to the underlying iron pipe. The other method, as used by the South Metropolitan Gas Co., depends upon the measurement of the electromotive force developed between the metal of the protected pipe and a copper plate immersed in water or other solution. An electromotive force is developed at once if and when water penetrates to the pipe material. It is also possible to discriminate between penetration through the actual protective coating and penetration to the metal through minute pinholes in the protection. In the latter case the electric current flowing will, owing to the very large resistance in the circuit be very small compared with that flowing when the coating itself has been more completely penetrated. The 2 methods have given comparable results when testing exceptionally good coatings but, for less perfect coatings, the results were not always reconcilable. Specimen curves are given. VVK (4)

The Passivity of Metals. VI. Comparison between the Penetrating Powers of Anions. SIDNEY CHARLES BRITTON & ULICK RICHARDSON EVANS. *Journal Chemical Society*, Vol. 133, Pt. 2, 1930, pages 1773-1784.

The penetrating power of different anions has been compared by the measurement of leakage current at an aluminum anode, with potassium chromate as a film-producing solute. The decreasing sequence of penetrating power for Al is Cl′, Br′, I′, F′, SO_4'', NO_3' HPO_4''. At a lead anode, the order is NO_4'', Cl_3', Br′, I′, HPO_4'', SO_4''. Ha (4)

Acid-Proof and Heat-Resisting Materials of German Origin (Säure- und wärmebeständige Werkstoffe deutscher Herkunft). H. KALPERS. *Korrosion, Beilage zur Chemischen Apparatur*, Vol. 6, Oct. 25, 1931, pages 45-47.

Among a number of special steels, a special cast iron (thermisilid) has proved to be particularly valuable for use as an acid-resisting and heat-resisting material. A comparison shows the following properties:

	Thermisilid about	Ordinary cast iron about
Melting Point	1220° C.	1150° C.
Density	6.9	7.2
Electric conductivity	1.05	1.3-2.0
Heat conductivity, reduced to cast iron	0.5	1.0
Bending strength	21.0	40-50
Sagging	1.0	2.0-2.4
Brinell hardness	290-350	150-250

A table shows the resistance to different acids and other attacking solutions. Ha (4)

High Chromium Steels in the Chemical Industry. F. M. BECKET (Electro Metallurgical Co.) *Journal Society Chemical Industry*, Vol. 51, Jan. 15, 1932, pages 49-52.

A general review of the industrial uses of Cr and Cr-Ni steels. Some recent developments include an alloy of 60% Ni, 20% Mo with small amounts of Mn and V for resistance to HCl; a cast alloy of 60% Ni, 17% Mo, 14% Cr and 5% W for resistance to chlorine and its compounds and also to phosphoric acid; and a cast alloy of 85% Ni, 10% Si and small amounts of Cu and Al for resistance to hot H_2SO_4. The author also announces a new alloy of 18% Cr, 6% Mn, 4% Ni, and 1% Cu. This steel has exceptional deep-drawing properties. It is slightly more resistant to a greater variety of chemical attack than the Cr-Mn-Cu steels and possesses a somewhat higher strength at high temperatures. VVK (4)

Modern Rustless Steels. A. C. ROWE. *Chemical Age*, London, Vol. 26, Jan. 30, 1932, page 90.

Four varieties of stainless steels with the base analyses identical are: stainless steels containing Cu, steels without Cu for tubes, steels with .5 to 1.0% W for parts to be welded where the work can not be normalized after welding and steels containing 3 to 4% Mo for resistance to H_2SO_4. Recent developments include a free-cutting stainless steel with a composition of .05 to .12% C, .25 to .5% Mn, .5% max. Si, 12.5-15.0% Cr, steel sheets veneered with stainless steel of a thickness of .015″ and heavier (an American development), a Cr-Ni steel wire rope to resist salt water or salt air and to operate at temperatures up to 900° C., a Ni-Mo iron for resistance to HCl and a 5% Cr steel for purposes requiring a fairly stainless steel at a lower price. VVK (4)

Field Measurement of the Corrosiveness of Soils. *American Gas Journal*, Vol. 134, Apr. 1931, pages 34-35.

Investigation of the corrosive action of soils on gas pipe lines made by the National Bureau of Standards has resulted in development of apparatus and formulation of a test procedure enabling distribution men to carry out same by measuring the electrical resistivity of most types of soil. MAB (4)

Coatings for Pipes. SCOTT EWING. *American Gas Journal*, Vol. 135, Nov. 1931, page 38.

See previous abstract. Investigations of coatings for pipe lines made by the American Gas Association with the coöperation of the Bureau of Standards covers the testing of specimens of 42 types of coatings in 14 different locations. The first group were removed from 11 locations after 9 months. Some buried by the Bureau of Standards were removed after a period of burial of 6 years. A third group were removed after a period of 17 years. These were prepared and buried by the United Gas Improvement Company. The specimens were subjected to various tests, measurements and inspections at the Bureau laboratory. The results show that thin coatings develop numerous pinholes, thick asphalt coatings do not prevent surface rusting, but do prevent pits. The pinhole test was considered the most satisfactory for determining the condition of the coatings. MAB (4)

Tarnishing of Metal Wares in Freshly Painted Show Cases. (Anlaufen von Metallgegenständen in frisch gestrichenen Auslagekästen.) FREITAG. *Oberflächentechnik*, Vol. 8, Dec. 15, 1931, page 256.

The author points out that drying oil paints form, under the influence of air, traces of formic acid, acetic acid, formaldehyde and acetaldehyde which may change the surface of metallic objects by forming metal oxides. Before using a freshly painted case every trace of such disintegration products of the oil paint should be removed by careful airing. Ha (4)

The Resistance of Copper-Nickel Steels to Sea Action. J. NEWTON FRIEND & W. WEST. *Engineering*, Vol. 131, June 12, 1931, page 774.

Condensed from paper read before the Iron and Steel Institute, London, May 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 248. LFM (4)

Temperature Rise as Cause of Friction Oxidation. (Temperature-erhöhung als Ursache der Reiboxydation.) MAX FINK. *Stahl und Eisen*, Vol. 52, Jan. 14, 1932, page 42.

It had been formerly contended that theory of friction oxidation (rolling oxidation) was once due to sharp increases in temperature at all the points of contact due to friction of the rolls. However, Tomlinson had discovered that the temperature plays only a subordinate part. Two steel rolls were subjected to a friction test of 50 kg. compression force and approximately 1% slip in an Amsler friction testing machine, the steel rolls being washed by a current of liquid air. Within a very short time, after only a low temperature rise, the characteristic dark coating appeared on the turning surfaces of the rolls. The test results thus confirm Tomlinson's view that the appearance of oxidation is not due to a rise in temperature on the contact surfaces of the two rolls. DTR (4)

The Theory of Metallic Corrosion in the Light of Quantitative Measurements—The Corrosion of Iron and Mild Steel. G. D. BENGOUGH, A. R. LEE & F. WORMWELL. *Proceedings Royal Society*, Vol. 134A, Nov. 1931, pages 308-343.

The oxygen absorption method of measuring corrosion which was developed for zinc has now been adopted for iron and steel. 2 types of corrosion-time curves have been obtained in KCl solutions, namely, exponential for weak and linear for strong solutions. Each is associated with a characteristic corrosion product. Hydrogen gas was evolved in all solutions and the proportion of the total corrosion due to this type of action was considerable in all solutions stronger than N/1000. The general shape of the hydrogen evolution-time curves were similar to those for the corresponding oxygen-absorption curves. Micrographic observations were made to supplement the corrosion velocity measurements. The results showed that the characteristic distribution of corrosion over completely immersed horizontal specimens was determined neither by initial air-formed film nor by differential aeration that could occur in stagnant solutions, but mainly by the distribution of a particular form of precipitated corrosion product. The deposits of rust which are usually supposed to behave as oxygen screens and stimulate corrosion by differential aeration do not so behave in any solution stronger than N/1000 KCl. The rust was found to consist almost entirely of ferric oxide and stable magnetic oxide. In very weak solutions in the presence of oxygen the rust was usually built up into coherent mounds which could not act as oxygen screens but gradually reduced corrosion rates. Highly purified iron gave nearly the same rate of corrosion as mild steel in N/10 KCl, but the rate of evolution of hydrogen gas was less. In conductivity water both purified iron and steel corroded at much higher rates than zinc, but in N/10 KCl much more slowly. The main causes of these differences are to be found in the different properties of the corrosion products. WAT (4)

Corrosion Phenomena in Tin Cans (Fenomeni di corrosione nelle scatoli di latta). O. CARRASCO & E. SARTORI. *Giornale di Chimica industriale ed applicato*, Vol. 13, Dec. 1931, pages 557-564.

Recent literature is reviewed with 7 references. 17 sets of observations on e.m.f. of Fe-Sn couples or couples between lacquered and unlacquered specimens of one or both metals are recorded, in electrolytes of citric or tartaric acid plus H_2O_2, H_2S, chlorides, etc. In many cases, the ordinary position of Fe and Sn in the electrochemical series is inverted in such electrolytes and the Sn acts protectively. Oxidizing additions make Sn more electronegative to Fe. Sulphur and H_2S make iron more electropositive. At a given pH in citric acid, chlorides lower the e.m.f. of the cell. Agitation decreases the tendency toward anodic behavior of either electrode. Lacquering of Sn diminishes its basic character without giving it cathodic relation to bare tin. Bare steel vs. lacquered steel, after a time, has the latter anodic. Rolled steel behaves differently from fused, in rolled iron. The latter is always less noble than tin. Theoretical discussion is given on the experimental observations. The authors admit that perforation is more common in lacquered tin coated cans used for acid fruits, but consider that a lesser evil than loss of color and taste in unlacquered cans. They do not approve the use of lacquered black iron without Sn. More attention to quality of steel, care in rolling and use of heavier tin coatings are urged. HWG (4)

Relation Between Pinholes, Electrical Conductivity, and the Protective Value of a Pipe Coating. Scott Ewing (Research Associate Bureau of Standards). *Gas Journal,* Vol. 195, Aug. 26, 1931, pages 488-489.

A contribution to the Distribution Conference of the American Gas Association, Apr. 1931. The measurements and tests which have been made so far indicate that it is possible to determine the protection afforded by a pipe coating with reasonable certainty by measurement of its conductance in a conducting solution after it has been buried. By a study of the canvas pad or some similar device it is believed that a rapid field method could be developed for determining the conditions of a coating on a pipe line. The thin coatings are decidedly inferior to the heavier coatings and it is doubtful if there is ever a combination of costs and circumstances on permanent lines which makes the application of very thin coatings (0.01 in. or less) justifiable. MAB (4)

Remarks on Corrosion Testing from the View-Point of the Designer. (Bemerkung zur Frage der Korrosionsprüfung vom Standpunkt des Konstrukteurs.) P. Brenner. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

Corrosion testing should aim to give the designer data on the behavior of materials and protective coatings under the actual corrosion conditions in practice. Of primary importance are data on the changes of the mechanical properties, as tensile strength, elongation, endurance limit as caused by corrosion. With light metal alloys laboratory corrosion tests have been developed which give results of satisfactory agreement with natural corrosion tests. Corrosion tests with simple specimens are incomplete since the results obtained are unfit to lead to conclusions on the behavior of complicated structural parts. GN (4)

Corrosion of Refinery Equipment. G. Egloff. *Oil & Gas Journal,* Vol. 28, Jan. 2, 1930, pages 42, 127.

Estimated loss due to corrosion of metals in the United States is $1,000,000,000 a yr. In the American Oil Industry alone the corrosion bill for 1928 is estimated at $135,000,000. Growing uses of corrosion-resistant products in the oil industry include Duriron, Everdur, Monel Metal, nickel aluminum, Ascoloy. VVK (4)

Potential Measurements and Solubility Tests on Copper-Tin and Copper-Zinc Alloys. (Spannungsmessungen und Lösungsversuche mit Zinn- Kupfer- und Zink- Kupfer-Legierungen.) O. Bauer. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

Measurements of potentials do not always indicate conclusions to be drawn on the behavior of a metal or an alloy in the electrolyte used. Oxidic layers or metallic deposits affect the results. Corrosion is essentially affected by the access of O, and corrosion in most cases then increases since O acts as a depolarizer. The attack of HCl on Cu and brass ceased when O was excluded. The loss of weight gives no clear picture of corrosion in many cases. This holds in particular for heterogeneous alloys. The determination of the alloying components which have gone into solution is necessary. The gradual change of the chemical composition of electrolytes must be studied in corrosion tests in still solutions, for metal ions going into solution can accelerate corrosion, as has been observed with Cu and brass in HCl. GN (4)

Electrochemical Protection of Aluminum Alloys against Corrosion by the Help of Zinc. (Elektrochemischer Schutz von Aluminiumlegierungen gegen Korrosion mit Hilfe von Zink.) G. W. Akimoff. *Zeitschrift für Metallkunde,* Vol. 23, Sept. 1931, page 249.

Corrosion tests in the Black Sea demonstrated that duralumin in contact with Zn would not corrode even for long periods. The protective action extends over large areas of the duralumin to portions greatly distant from the point of contact with the Zn. An electrochemical explanation is advanced. See also *Metals & Alloys,* Vol. 1, Aug. 1930, page 690. RFM (4)

A Modern Soil Survey with Shepard Rods. Arthur B. Allyne (Southern Counties Gas Co. of Calif.) *Gas Age-Record,* Vol. 68, Aug. 22, 1931, pages 269-272, 282.

Shepard rods are 2 steel cane electrodes, about 36 inches long, bakelite covered except the tips, that support 2 small dry cells and a resistance-meter which measures the resistivity of the soil at the depth the pipe is to be laid. 2 holes are dug about 1 ft. apart with a 2 in. post hole digger to pipe depth. Upon connecting these canes together at the top with a battery wire, a direct reading is obtained in ohm-cm. that is translated into probable pipe life for that location. In general the correlation is as follows:

Rod readings ohm-cms.	Probable life of bare steel pipe years
0 — 1000	0 — 9
1000 — 2500	9 — 15
2500 — 10,000	15 or more

Any soil that gave a reading below 1000 would require heavy pipe protection, between 1000 and 2500 moderate protection and above 2500, light protection or none at all. The Shepard rod appears to be satisfactory for alkali or western soils but not for acid soils. The author describes the survey of their distribution system; one district of the 8 comprising the system was surveyed in 41 days and states that the work will be completed in one to 2 years. VVK (4)

The Attack-Reducing Effect of Sodium-Silicate to Bromide and Chlorine Water and Calcium Chloride Solutions. (Ueber die Angriffsvermindernde Wirkung von Wasserglaszusätzen zu Brom-und Chlorwasser bezw. Chlorkalk-Lösungen.) H. Bohner. *Aluminium Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Sept.-Nov. 1931, pages 347-348.

It has been found that additions of sodium-silicate to the above mentioned solutions lessens or even entirely prevents the corrosive action on Al. Tables showing the effect with various amounts from 0.1 to 15% on various Al alloys are reproduced. Ha (4)

Rust Prevention. (Rostschutzmittel.) A. Bresser. *Oberflächentechnik,* Vol. 9, Jan. 19, 1932, pages 11-14.

The chemical causes and nature of rust (iron-oxides) are discussed and means described to prevent this damage as much as possible. The treatment with phosphate coatings. ("Coslettize" and "Parkerize") is explained; it consists principally in dipping the well cleaned articles in a boiling bath of phosphoric acid and iron phosphate. These coats are flexible, the various modifications of treatment are described. Further protection is obtained by coats of bitumina, tars, pitches, gutta percha, rubber, natural and artificial resins; silicium-tetra-chloride, nitriding and chroming are briefly discussed. Ha (4)

Artificial and Natural Formation of Protective Layers in Water Pipes (Ueber künstliche und natürliche Schutzschichtbildung in Wasserleitungsröhren). L. W. Haase. *Gas und Wasserfach,* Vol. 74, June 13, 1931, pages 572-576.

Refers to pipes for hot and cold water and considers mainly the behavior of iron, lead and copper pipes. EF (4)

The Corrosion of Aluminium Alloys. Henry Gibb. *Metal Industry,* London, Vol. 40, Jan. 8, 1932, pages 27-30, 34.

Strips of Al alloys, cast both before and after being treated with Cl gas, were placed at the sea shore so that they were submerged by each tide. The strips were cleaned at regular monthly intervals for 6 months. Tables give the results in loss in weight. An alloy containing 84.28% Al, 14.40% Zn, 0.39% Si, 0.48% Fe, 0.50% Cr was the most resistant, losing 1.7 mg./cm.^{2}/400 days. Pb and Si are suitable addition elements but calcium silicide is not. Al alloys containing Cu in excess of 2.5% are unsuitable for corrosion resistance. Gassification increases the resistance to corrosion of the Al-Zn-Cr alloys with the exception of those containing 5-8% Si and 0.1% Ca. PRK (4)

Methods and Apparatus for Testing Corrosion Resistance of Metals. (Über Methoden und Apparate zur Korrosionsprüfung von Metallen.) G. Gollnow. *Die Chemische Fabrik,* Vol. 4, Aug. 5, 1931, pages 326-328; Aug. 12, 1931, pages 335-336.

A review, including 14 references. Loss in weight of samples of metals is determined after immersing them in the corroding solution for a long period or in a solution of greater strength for a short period. Solutions of acids, salts and H_2O_2 are used. Accelerated tests are made by using a spray or by 2 electro-chemical methods, Duffek's method of measuring difference of potential or Tödt's method. For Al, a solution of 3% NaCl and 0.1% H_2O_2 is suitable. Another accelerated method is to alternately immerse in a solution and expose to the air. CEM (4)

The First Corrosion Symposium. (Erste Korrosionstagung, Berlin.) *Zeitschrift für Metallkunde,* Vol. 23, Nov. 1931, pages 316-319.

Brief account of the first corrosion symposium held by the Verein deutscher Eisenhüttenleute, Verein deutscher Ingenieure, Verein deutscher Chemiker, and Deutsche Gessellschaft für Metallkunde, Berlin, October 20, 1931. RFM (4)

Purpose and Aim of Coöperative Research in the Field of Corrosion and Protection Against Corrosion. (Zweck und Ziel der Gemeinschaftsarbeit auf dem Gebiete der Korrosion und des Korrosionsschutzes.) P. Goerens. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

The paper emphasizes the need of a closer coöperation of all groups interested in the problems of corrosion due to the complicated nature of its problems, in order to avoid unreasonable arguments between producer and consumer, to get a better evaluation and compilation of data referring to corrosion and to give the metallurgist new stimuli to produce new materials. An outline is given by which this coöperation may be effected. GN (4)

Corrosion in Shipbuilding. (Die Korrosion im Schiffbau.) E. Goss. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschrift für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

Deals with corrosion on plates, riveted joints, steam engines, turbine blades, Diesel engines, water mains, etc. GN (4)

Protection of Metals from Corrosion. (Protection des Métaux contre la Corrosion.) J. Glaymann. *L'Usine,* Vol. 41, Jan. 8, 1932, pages 29-31.

The different means of protecting metals from corrosion by electroplating with Cr, Ni, Cd, etc., by chemical means, that is surface treatment by oxygen, phosphates, Al, Pb, etc., are discussed and explained. Ha (4)

Correlating Soil Characteristics with Pipe-line Corrosion. I. A. Denison (Bureau of Standards). *Gas Age-Record,* Vol. 65, Apr. 19, 1930, pages 544-546.

Paper before the American Gas Association Distribution Conference, St. Louis, Apr. 1930. A corrosion soil survey was made of a 32-mile section of a group of pipe lines in the southeastern Great Lakes region. It was found that the corrosivity of the soil was a function of the acidity and drainage of the soil. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA32. VVK (4)

A New Apparatus for Testing Materials for Corrosion and Erosion Resistance (Ein neuer Apparat zur Prüfung von Baustoffen auf Korrosions -und Erosions -Beständigkeit). W. Denecke. *Die Chemische Fabrik,* Vol. 4, Sept. 2, 1931, pages 358-359.

The apparatus consists of 2 vessels, each closed at the top by a stopper and connected near the top and at the bottom by tubes. A stirring device passes through the stopper of the vessel in which the sample is placed, the paddles being below the solution level. The tip of a large burette passes through the stopper of the other vessel and a stopcock is connected to the lower connecting tube, forming a means of introducing or draining out part or all of the solution. By means of the stirrer, the solution can be circulated through the 2 vessels and it is possible to keep it a constant strength or change it at will through the inlet and outlet without removing the sample. CEM (4)

The Corrosive Effect of Gasolines and Motor Benzols on Copper. F. H. Garner & E. B. Evans. *Journal Institution of Petroleum Technologists,* Vol. 17, July 1931, pages 451-463.

Considerable attention has been directed in recent years to the corrosive action that certain motor fuels exert upon the metal parts of the fuel systems of automobile and aircraft engines. Free sulphur has been shown to be an active copper-corroding agent, while certain sulphur compounds containing loosely attached sulphur also cause this formation of sulphide. The problem of detecting and identifying the corrosive elements, with a view to their elimination and of devising satisfactory tests for the detection of corrosive action and the estimation of the amount of deleterious matter present is obviously of interest to the refiner and marketer of motor fuels. A summary of the previously published literature on this subject is given in this paper and is followed by an account of experimental work carried out with the objects of selecting the most satisfactory test for corrosion and devising a convenient and accurate method for the estimation of free sulphur, together with some discussion of the results. WHB (4)

Some Water Works Corrosion Problems. Ira D. Van Giesen (Dep't of Water and Power, Los Angeles, Calif.) *Journal American Water Works Association,* Vol. 22, Jan. 1930, pages 36-48.

Various examples of relatively rapid corrosion are given. An open equalizing tank painted with a water-emulsified asphalt showed breakdown of the paint coating on the north side where it was exposed to the rays of the sun when not covered with water. The heat of the sun had expanded the air particles in the emulsion pushing the coating away from the metal and exposing it to attack. The remedy suggested is covering the tanks and in using other than an emulsified paint unless the paint is emulsified under vacuum. A case of graphitized cast iron, due to stray current electrolysis, showed a surface layer of black, then a layer of yellow, then a layer of brown, and finally the unaltered iron. The analyses of these constituents follow:

	Corroded	Yellow	Brown	Unaltered
Si	7.07 %	6.97 %	2.04 %	1.73 %
Mn	0.51	0.45	0.38	0.37
P	2.22	2.04	0.97	0.83
S	0.023	0.018	0.061	0.060
Combined C	0.32	0.09	0.52	0.65
Graphitic C	11.28	9.15	3.68	2.40

"It would appear that the process of graphitic corrosion calls for an internally stressed cast-iron in which the combined C has a tendency to precipitate out of the solid solution as graphite, and the presence of a highly ionized soil. The primary cause is inherent in the cast iron, and the soil is a secondary factor. The remedy, then, would be a protective coating applied to the surface of the cast iron to insulate it from the soil moisture. This would be efficient only as long as the coating was intact. Better cast-iron is probably a better solution." Cases of corrosion due to dissimilar metals in contact are mentioned with the recommendation that the same metal should be used throughout and if it is necessary to change the type of metal used, to coat the pipes for several feet in both directions from the point of metal-change with asphaltum compound. VVK (4)

The Grounding of Telephone Cable Sheaths to Water Pipes. Ira D. Van Giesen (Bureau of Water Works & Supply, Department of Water & Power, Los Angeles, Calif.). *Journal American Water Works Association,* Vol. 23, Feb. 1931, pages 149-159.

The grounding of noise-producing currents of aerial telephone cables to water pipes has no effect from a corrosion standpoint. These currents have frequencies from 50 to 3000 cycles and their magnitude and energy are small. However, if the locality is served by an electric street railway with the usual track return system, there *may* exist a difference of ground potential between the 2 areas connected by the pipe system and the grounded aerial cable which will result in corrosion. A condenser of sufficient capacity to handle the noise currents and of a sufficiently high potential rating to withstand the direct ground potential connected in the grounding circuit is all that is necessary to prevent corrosion. VVK (4)

Oxygen as a Factor in Submerged Corrosion. E. C. Groesbeck & L. J. Waldron. *Proceedings American Society for Testing Materials,* Vol. 31, Part 2, 1931, pages 279-293.

Includes discussion. See abstract of preprint, *Metals & Alloys,* Vol. 2, Oct. 1931, page 208. HWG (4)

Investigation of the Use of Fatty Substances for Protecting Aluminum from Chemical Reactions (Essais sur l'emploi de corps gras en vue de la protection d'aluminium contre les altérations chimiques). A. Trillat. *Revue de Métallurgie,* Vol. 27, July 1930, pages 341-343; *Chemie et Industrie,* Vol. 25, Jan. 1931, page 83.

See *Metals & Alloys,* Vol. 1, Dec. 1930, page 902. (4)

Service Pipes of Various Materials. R. W. Reynolds (West Palm Beach Water Co.). *Journal American Water Works Association,* Vol. 23, May 1931, pages 658-666.

Data and curves are given for the friction loss of corroded and uncorroded galvanized pipe, cement-lined pipe and copper tubing. VVK (4)

Study of the Couple Fe, FeS. The Passivity of FeS (Étude du Couple Fe, FeS, Passivation de FeS). A. Travers & Jean Aubert. *Chimie et Industrie,* Vol. 26, Nov. 1931, page 1040.

Discussion of the corrosion of iron with reference to attempts to determine the value of the electrolytic compounds formed in steels. Armco iron seems to resist corrosion by S very well, a report of 2 very mild steels having a content of S only up to 0.025%. In testing the corrosion of iron by H_2S, it is very important that the S used in preparation of the sulphide be free from iron. Iron sulphide is passive in oxidizing, especially in a solution of 5% chromic acid but, in a concentrated acid, the sulphur is active and has a potential much higher than iron. Hence, it is necessary, in preparing the H_2S, to have an acid with a concentration high enough to act on the iron to remove the FeS. MAB (4)

Corrosion of Tinned Equipment in the Milk Industry, Causes and Prevention (Korrosion verzinnter Apparate, Ursachen und Verhütung). W. Mohr & M. Schulz. 58 pages, 27 figures. Published by *Milchwirtschaftliche Zeitung*, Stendal, 1930.

Reprint of serial publication in *Milchwirtschaftliche Zeitung* during 1930. A study of black spots on tinned copper used in the milk industry. A long series of experiments is described in detail. It is concluded that the spots form because of solution of Sn and subsequent oxidation of the tin salts. Oxidation may occur through use of sodium hypochlorite as disinfectant, through bacterial action, etc., or by anodic oxidation from stray currents or from cells set up by scratching through the Sn, or the use of untinned bronze parts in connection with the tinned apparatus. Tinning flux not removed, or copper salts in the flux cause a dark coloration, as do SO_2 or H_2S. The best prevention from black spots is careful tinning, including removal of all flux, freedom from scratches and porosity. Good dip tinning, or a combination of tinning by wiping and metal spraying pure tin on the hot first coat, followed by polishing of the sprayed coating, is required. Metal spraying by itself does not give a sufficient pore-free coat. Cd-Zn is alleged to form a better coating but Cd should not be used on surfaces to come in contact with milk products. HWG (4)

Pyrophoric Iron on the Hoops of Acetic Acid Containers (Pyrophores Eisen an den Reifen von Essigbildnern). C. Luckow. *Korrosion und Metallschutz*, Vol. 7, Sept. 1931, page 210.

Attention is called to a phenomenon met with in acetic acid factories, i.e., the formation of basic Fe^{III} acetate which displays pyrophoric properties. EF (4)

The Capacity of Aluminium Articles to Resist Chemical Attack. (Zur chemischen Widerstandsfähigkeit von Aluminiumgeräten.) A. Klepp. *Apparatebau*, Vol. 43, Mar. 20, 1931, page 67.

A low resistance to corrosion of Al articles is always due to a high content of Fe and Si. The use of Al vessels, etc, for organic acids is entirely unobjectionable. Ha (4)

Corrosion of Metals by Phosphoric Acid. Peter R. Kosting & Conrad Heins, Jr. (Bureau of Chemistry and Soils, Washington, D. C.). *Industrial & Engineering Chemistry*, Vol. 23, Feb. 1931, pages 140-150.

The paper contains valuable data on the corrosion of metals by C. P. and crude phosphoric acids. Accelerated corrosion tests were carried out with 52 metals and alloys, under various conditions, using 10%, 25%, 50% and 85% acids. The effect of temperature, aeration, and purity of solution were investigated, and the physical appearance of the metals after exposure was noted. It was found that temperature rise increases the rate of corrosion. In concentrated acid, the corrosion rates of stainless steels suddenly increase near the boiling point. The purity of the acid affects the resistance of metals to phosphoric acid. Products of corrosion tend to increase the corrosion of the special brasses and bronzes. Halogens destroy the passivity of stainless irons and steels and so cause rapid corrosion. As, hydrochloric acid, pine oil, mucilage, and pyridine inhibit the attack of concentrated acid on Fe. Sulphuric acid increases the corrosion rate of Fe, brasses, etc. but cuts down that of Pb. Aeration increases the corrosion of non-ferrous metals and alloys. Bibliography of 50 references. MEH (4)

Methods of Testing the Corrosion of Metals. (Sur les méthodes d'essais de corrosion des métaux). E. Herzog & G. Chaudron. *Comptes Rendus*, Vol. 194, Jan. 11, 1932, pages 180-181.

The authors discuss a paper by J. Cournot (*Comptes Rendus*, 1931, 193, 1337) in which reference was made to the application of mechanical tests after corrosion for the purpose of distinguishing between corrodible and non-corrodible materials. They then point out that they had previously published a description of a method of testing corrosion, in which not merely the loss in weight of the specimen but the alteration in its mechanical properties was made the measure of its resistance to attack. This method of testing consisted in the use of a stamping test (presumably a type of Erichsen test), which enabled a very clear distinction to be made between local and general corrosion in the case of test pieces which had been subjected to attack. This type of test has proved of particular value in the examination of such Al alloys as Duralumin, which have been corroded in seawater. The article is accompanied by 1 table. OWE (4)

Corrosion in Refrigerator Installations (Korrosion in Kühlanlagen). M. Hirsch. *Zeitschrift für die gesamte Kälte-Industrie*, Vol. 37, Dec. 1930, pages 231-233.

Gives information published mainly by the American Society of Refrigerating Engineers. EF (4)

Rust Protection of Wire Products with Cadmium. C. M. Hopp. *Wire & Wire Products*, Vol. 6, Nov. 1931, pages 427-434, 447.

The properties of Cd, methods of application to wire products, the equipment required and recent developments in connection with inhibitors are fully described. The most important is the electrolytic method wherein Cd is electrodeposited on the iron and steel products in a suitable electrolyte. Dipping and spraying can also be employed. As inhibitor in the pickling process, hydrochloric acid is used. The deposit of Cd is very dense and relatively non-porous, so that it makes a good protection against rusting. 10 references. Ha (4)

Non-Rusting and Heat-Proof Chrome-Cast-Iron Alloys. (Ueber nichtrostende und hitzebeständige Chrom-Gusseisenlegierungen.) E. Houdremont & R. Wasmuht. *Krupp'sche Monatshefte*, Vol. 12, Dec. 1931, pages 331-337.

The Fe-C diagram at the presence of very high amounts of Cr is discussed and the causes for the great corrosion resistance explained by the behavior of the chromium carbide Cr_7C_3; a content of about 13% Cr in cast iron shows a remarkable improvement in the corrosion resisting properties. A table is given in which the results with a few alloys of this kind are given when subjected to attack by acids, alkalies and solutions, and also for behavior at temperatures up to 1000° C. A few examples are illustrated of the use of this cast iron in ornamental castings and other commercial ware. Ha (4)

The Preparation of Water for Railroad Use. C. H. Koyl. *Journal American Water Works Association*. Vol. 22, July 1930, pages 912-918.

The history of water softening on American railroads; the prevention of boiler pitting by (1) maintaining 15 gr./gal. caustic alkalinity in the boiler water, (2) coating the inside of the boiler with metallic arsenic and (3) an open feed water heater; the prevention of foaming by the addition of a little castor oil. VVK (4)

The Present State of Pipe Protection in Municipal Gas and Water Conduits (Gegenwärtiger Stand der Rohrschutzfrage für städtische Gas- und Wasserleitungen). Kröhnke. *Gas und Wasserfach*, Vol. 74, Dec. 12, 1931, pages 1155-1159.

Requirements to be met with in the protection of pipe lines against physical, chemical and electric influences, and present state of failure prevention. The anti-corrosion information refers mostly to non-metallic coatings. EF (4)

The Economics of Steam Purification. L. F. Kuhman. *National Engineer*, Vol. 35, Aug. 1931, pages 258-262.

The importance of absolutely dry and clean steam in the operation and maintenance of steam lines is noted and examples of destructive corrosion are cited. Ha (4)

Rust in Vinegar Plants (Ueber die Rostbildung in den Essigfabriken). C. Luckow. *Korrosion und Metallschutz*, Vol. 7, Sept. 1931, page 209.

The paper deals mainly with the rusting process of cask hoops and its prevention. The influence of acetic acid in addition to the influence of water and oxygen upon the rusting of iron is discussed. EF (4)

Some Fundamental Considerations of Corrosion in Steam and Condensate Lines. R. E. Hall. *Heating, Piping & Air Conditioning*, Vol. 3, Nov. 1931, pages 943-959.

Presents the results of an investigation, covering a period of a year, into the factors influencing corrosion in steam systems. The investigation includes a study of the raw water and the production, the distribution, and the utilization of steam, with reference to heating systems and appliances only. Data are presented in full showing the extent and constitution of deposits in the heating systems in a large office building and a large hotel in New York City. These deposits were found to originate from the action of corrosion and were found to contain little or no evidence of carry-over from the boilers. The cause of the excessive corrosion was found to be the inleakage of air into the vacuum return system. The amounts of oxygen and carbon dioxide associated with the steam are shown to be insignificant as corrosion agents by the application of the law of Henry and Dalton. The cause of corrosion in heating systems can, therefore, be sought in the operation and, to a small extent, in the design of the systems and not in the quality of the steam used if that quality equals that encountered in these studies. WAT (4)

Some Fundamental Considerations of Corrosion in Steam and Condensate Lines. R. E. Hall & A. R. Mumford. *Heating, Piping & Air Conditioning*, Vol. 3, Dec. 1931, pages 1041-1049.

The factors that control the relations of steam to metal in steam heating systems are thought to be of 2 general types: (1) formation at various points in the utilizing system of troublesome deposits, the origin of which was primarily carryover of boiler water and sludge by the steam; (2) corrosive action, and formation of deposits thereby in the utilizing system, with the question to be answered of what responsibility, therefore, should be borne by the steam furnished by the generating system. According to the generally accepted view, corrosion in all cases comprises a velocity or intensity factor and a quantity factor. The velocity factor is a function of the pH value of water, since the rate of dissolution of iron is dependent on this. The quantity factor is a function of available dissolved oxygen. From the standpoint of elimination of corrosion, the ideal would be zero intensity and quantity factors; since this is impossible in practice, it is necessary to establish for both factors tolerances that provide sufficient limitations to render the corrosive action inappreciable in amount. The lower limit obtainable for dissolved oxygen with a deaerating heater is approximately 0.025 c.c./liter. This value in practice is considered satisfactory. When corrosion does occur in systems, it is usually restricted to well defined areas where special conditions exist. In such cases special remedies are required. Return lines in systems using exhaust steam from reciprocating engines rarely show serious corrosion due to the protection afforded by the oil film, or by the maintenance of high pH value in the condensed steam by the carryover of boiler water. The pH value is practically dependent upon the amount of carbon dioxide associated with the steam, when the water is condensate derived from steam which was generated from alkaline boiler water. In many cases, mechanical changes in the system are advantageous, such as the substitution of copper or brass for steel, care being taken to avoid bi-metallic contacts at the joints. WAT (4)

On the Passivity of Metals. W. J. Müller. *Transactions Faraday Society*, Vol. 27, Dec. 1931, pages 737-751.

Contains 31 references. Quantitative formulae are developed relative to the study of passivity on the basis of the electron theory of metals. Anodic passivity is characterized as a time phenomenon and has a definite upper limit of current density in the case of the metal having a soluble or non-existing film on it. When metal is covered with an insoluble film, "layer polarization" is encountered. In this case the initial current density and passivating period are simply related. Chemical passivation consists either in the evolution of oxygen at the anode or in solution at a higher valency, and can only take place when the current density in the pores of the film exceeds such a definite critical value as causes a change of the underlying metal in the pores. PRK (4)

Soil Corrosion Studies of the U. S. Bureau of Standards. K. H. Logan (Bureau of Standards). *Gas Journal*, Vol. 195, Aug. 19, 1931, pages 435-436.

Attempts are being made to obtain data of immediate practical use to the owners of underground pipe. There are 2 problems involved: the location of corrosive sections and the choice of protection against corrosion. The article discusses the progress made thus far in carrying out the tests, but no conclusions or results have been obtained. MAB (4)

Long Life of Structural Steel Piles. R. C. MANNING. *Canadian Engineer*, Vol. 61, July 7, 1931, pages 25-26.

7 steel trestle highway bridges built about 1900 in the vicinity of Chatham, Ont., were inspected by the author. They had apparently received no attention, were exposed to high and low fresh water, had not been painted and were in excellent condition. Although the surface of the steel was somewhat pitted there was no evidence of serious corrosion. The steel piles were not corroded at the water line or in the area between the present water line and the high water mark, which could be readily seen by the deposit of a light colored silt coating on the piles. VVK (4)

Soil Corrosivity Surveys of Great Value. K. H. LOGAN (Bureau of Standards). *Oil & Gas Journal*, Vol. 30, June 4, 1931, pages 28, 282-284.

Presented before the Division of Production, American Petroleum Institute, Dallas, Texas, June 1931. The variation of corrosivity of soils in the same location is shown by the calculated average life of 3 8" parallel pipe lines placed within a few feet of each other. The average lives were 26.6, 21.3, and 17.1 yrs. Chemical tests for identifying corrosive soils when unsupported by other data have proven rather unsatisfactory. While the presence of large amounts of acids, sulphates or chlorides indicate corrosiveness, corrosion has been found in the absence of these indicators of bad soils. Usually simple electrical tests will serve as well to identify corrosive soils as the more difficult chemical analyses. Among the chemical methods used are those of Holler who used a mixture of iron filings, soil and water and measured the hydrogen evolved and Grodsky in which very thin steel disks are placed in crystallizing dishes filled with soil and maintained at a constant temperature for 2 weeks. Among the electrical tests used is that of Putnam who used a coil of wire in a sample of soil and maintained a potential of 2 volts from one end of the coil to the other. After 96 hrs., the wire was examined for the location of the corrosion and the potential required to cause current to flow through the soil calculated. This apparatus was later modified. A potential of 1.4 volts is impressed across the soil through steel plates and after 10 minutes the current flowing through the soil is measured by a milliammeter. Shepard measured the current discharged from a pipe line. He also designed 2 rods for measuring the resistivity of the soil at the depth of the pipe. A method used by Williams and Corfield is the imposition of an e.m.f. on a piece of pipe placed in soil in a tin can, the loss of weight after a definite time indicating the corrosivity of the soil. A soil rod developed by Legg consists in a steel anode and a copper cathode placed at a definite distance apart, the current developing from the corrosion of the steel being measured by a milliammeter. Most, if not all, of the methods for identifying corrosive soils have been shown by their originators to be reasonably satisfactory under some conditions. None of the methods have been used extensively enough to permit defining their limitations. VVK (4)

An Example of Internal Corrosion in Brass. (Example de Corrosion du Laiton). G. MANDRAU. *Aciers Speciaux, Metaux et Alliages*, Vol. 6, June 1931, pages 293-294.

After a service of 15 yrs., a brass bolt was found subjected to internal corrosion, though no external agent was present to promote a galvanic effect. This bolt exhibited 3 distinct layers which had different compositions, yet the original metal was uniform in composition. The exterior part contained: 96% Cu, 0.56% Fe, 3.2% Zn. The intermediate layer contained: 67% Cu, 0.38% Fe, 32.5% Zn. And the core contained: 57.5% Cu, 0.42% Fe, 41.8% Zn. Microscopic examination revealed the presence of internal corrosion of galvanic origin between the constituents Cu-Zn of brass. GTM (4)

The Significance of the Hydrogen Absorption in the Solution of Iron (Die Bedeutung der Wasserstoffaufnahme beim Lösungsvorgang des Eisens). E. LIEBREICH. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 155, July 1931, pages 123-142.

The phenomena on which Evans bases his corrosion theory of aeration occur in an atmosphere of hydrogen, too. Liebreich, therefore, assumes a catalytic effect of the bivalent corrosion products, the distribution of which is materially dependant on hydro-dynamic currents. The author shows that the bivalent hydroxides originated at the Fe-surface render the potential less noble and result in an accelerated dissolution of the iron. The same phenomenon takes place in diluted 1/10 *N* H_2SO_4 in the presence of H_2 at the surface of Fe covered with fine glass powder. The cathodic overvoltage on corroded iron surfaces was found to be lower than on fresh surfaces; this effect is ascribed to the concentration of the hydrogen liberated. EF (4)

Early Steps in the Development of the Columbia Soil Rod. BUELL B. LEGG (Columbia Engineering & Management Corp.). *Gas Age-Record*, Vol. 67, Jan. 24, 1931, pages 111-118.

The Columbia Soil Rod for determining the corrosivity of soils is described and illustrated and the data obtained, charted. VVK (4)

Two Years' Progress in Corrosion Resistance. J. A. MATHEWS. *Paper Trade Journal*, Vol. 92, Mar. 5, 1931, pages 57-58.

A brief review is given of some of the causes of failures of 18-8 alloys, particularly in the sulphite industry. The latest metallurgical theories are given relative to carbide precipitation, and the need for proper heat treatment of metals is stressed, as well as the chemical composition of the alloys. Means of preventing metal embrittlement is indicated. Ha (4)

The Life of House Connections with Respect to Material, Inside Diameter, and Composition of the Water. (Die Lebensdauer von Hausanschlussleitungen in Abhängigkeit von Material, Lichtweite und Wasserbeschaffenheit.) F. MEYER. *Das Gas- und Wasserfach*, Vol. 74, July 25, 1931, pages 703-710.

Presented before 72nd annual meeting of the Deutsche Verein von Gas- und Wasserfachmännern, June 8-10, 1931. Includes discussion. Old cast iron pipes used in the city of Chemnitz for transmission of water supply are compared with more recent wrought iron piping. The latter had longer life. Since lead and zinc were attacked by the water, copper connections were used in the houses. Samples of the water taken from the supply each year since 1919 were analyzed, and the results are presented in a table. Results are also given of the attack of the water on lead and zinc. MAB (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

The Crystal Structure of Copper Electrodeposited in the Presence of Gelatine. H. KERSTEN. *Journal of Physical Chemistry*, Vol. 35, Dec. 1931, pages 3644-3646.

The author refers to work by Trillat (*Revue de Métallurgie*, Vol. 25, 1928, page 286) who found apparent but not conclusive evidence for a difference in the length of the edge of the unit crystal lattice for Cu which had been deposited in the presence of gelatine from that which had been deposited under more normal conditions. His experiments show that any difference in the unit crystal lattice edge of the 2 types of deposited Cu is less than 0.01 A.U. The article is accompanied by 5 figures and 1 table. OWE (5a)

Results up to the Present Time on the Investigation of Equilibrium Systems in the Production of Steel. (Die bisherigen Ergebnisse der Untersuchung der Gleichgewichts-systeme bei der Stahlerzeugung). FRANZ SAUERWALD, in collaboration with WERNER HUMMITZSCH, (Berlin). *Archiv für das Eisenhüttenwesen*, Vol. 5, Jan. 1932, pages 355-366.

Includes summary of all equilibrium constants and deviations in results, 22 references, 14 tables and 10 diagrams. The following systems were critically examined: Fe-O, Fe-FeO-CaO, Fe-O-C, Fe-Si-O, Fe-Mn-O, and P-S. In many cases the observed results of one investigator are different than those of others, and only in the Mn systems is the number of check values greater, perhaps due to greater number of investigations carried out on Mn equilibrium systems. The writers found it of importance to ascertain for future work whether the law of mass action or a definite equilibrium condition applies, as in the Guldberg-Waage $K = \frac{C_a \times C_b}{C_c \times C_d}$ equation, whether for changes in concentration, the value K remained constant. DTR (5a)

A Micro-Furnace for Temperatures above 1000° C. (Ueber einen Mikroofen für Temperaturen oberhalb 1000° C.) H. S. ROBERTS & G. W. MOREY. *Zeitschrift für Instrumentenkunde*, Vol. 51, July 1931, pages 385-386.

See *Metals & Alloys*, Vol. 2, Mar. 1931, page 65. EF (5a)

Macro-Printing. *Metallurgist*, Mar. 1931, pages 46-47.

A review of some recent references. VVK (5a)

Nickel-Chromium and Iron-Nickel-Chromium Alloys. *Metallurgist*, Sept. 1931, pages 134-136.

A critical review of 9 references on the equilibrium diagrams of the systems, Fe-Ni, Fe-Cr and Ni-Cr. VVK (5a)

The Interpretation of the Deformation Texture of Metals (Zur Deutung der Deformationstexturen von Metallen). W. BOAS & E. SCHMID. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 17, 1931, pages 53-56; *Zeitschrift für technische Physik*, Vol. 12, Feb. 1931, pages 71-75.

Assuming that a crystal embedded in a poly-crystalline metal has a deformation differing from that of a free single-crystal, at least 3 systems of translation are involved in the formation of the texture of cubic metals developed in tension and compression. The texture of the rolled metal depends on whether the tensile or the compressive texture predominates. That texture which results is stable under tension in the direction of rolling and compression normal to it. The arrangement is discussed for body-centered and face-centered cubic metals. Ha+HWG (5a)

The Influence of Hydrostatic Pressure on the Critical Temperature of Magnetization for Iron and Other Materials. L. H. ADAMS & J. W. GREEN. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, Aug. 1931, pages 361-380.

Measurements were made of the effect of pressure on the magnetic inversion-temperature (Curie point), 5 ferro-magnetic materials—Fe, Ni, magnetite, a 35% Ni steel and a meteoric iron—were tested in the form of small transformers and subjected to pressure in a water-jacket bomb. The tests show that the effect of pressure on the Curie point is practically nil although the possibility of a slight decrease in temperature with increasing pressure is not excluded. Since the energy change is of considerable magnitude, the volume change accompanying the magnetic transformation is, consequently, zero or very small. The author concludes that the Ni-Fe core of the earth must be far above the temperature at which it could be magnetic because its great volume has no important influence on the earth's magnetic field. Ha (5a)

The Equilibrium of Certain Non-Metallic Systems. J. H. ANDREW *et al. Iron & Coal Trades Review*, Vol. 123, Oct. 2, 1931, pages 491-492.

Paper before the Iron & Steel Institute, Sept. 1931. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 7. Ha (5a)

Investigations on the Iron-Oxygen System (Untersuchungen über das System Eisen-Sauerstoff). H. SCHENCK & E. HENGLER. *Archiv für Eisenhüttenwesen*, Vol. 5, Oct. 1931, pages 209-214.

Report of the Institute of Metallurgy at the Technische Hochschule Aachen; Doctor thesis of E. Hengler. Since it is practically impossible, because of the miscibility gap, to make iron alloys containing more than 0.2% O; the specimens for this investigation were made by mixing finely ground metallic iron with FeO and compressing this mixture. The transformations of a group of Fe-O alloys, containing 0.072%, 0.11%, 0.15%, 0.16%, 0.21%, 0.25%, 0.29%, 0.42%, 0.58%, 1.07%, 1.80%, 2.55%, 2.82%, 6.2%, and 8.38% O_2 were studied by means of a Saladin apparatus according to Roberts-Austen. The thermal analysis as well as diffusion tests and microscopic examinations show a critical point at the concentration of 0.2% O_2 which is assumed to be the limit of solubility of O in solid iron between A_3 and A_4. Up to 0.2% O_2, A_3 is probably somewhat lowered and A_4 is slightly increased at the most about by 3° C. By determining the melting points, an attempt was made to establish the solidus and liquidus line of the partial diagram FeO-Fe_3O_4. The phase changes in solid state among FeO and Fe_3O_4 were microscopically examined. These results and those of previous investigations were used to re-establish the system FeO with as much as 28% O_2. GN (5a)

The Constitution of the Aluminum-Rich Al-Fe-Si Alloys (Die Konstitution der aluminiumreichen Al-Fe-Si-Legierunger). V. Fuss. *Zeitschrift für Metallkunde,* Vol. 23, Aug. 1931, pages 231-236.

See *Metals & Alloys,* Vol. 2, Dec. 1931, page 301. (5a)

Seeing with Invisible Light. Herbert W. Forster. *Scientific American,* Vol. 146, Jan, 1932, pages 7-11.

Describes the microscopic work on metals carried out at the Bell Laboratories in New York City. A microscope objective of given numerical aperture, when used with light of given wave-length, has some fixed limit of resolution, but the ultra-violet microscope developed by the Bell Laboratories appears to have a potential resolving ability probably greater than twice that of the apochromatic system. Micrographs of steel have been successfully obtained by this method at diameters ranging from 5000 to 9000. The difficulty is that at this high magnification the observer cannot be certain of what he is seeing. The image of the test piece is reflected on a fluorescent screen of uranium glass. By this method the difficulties encountered with ultra-violet light in connection with quartz lenses are corrected. Mention is made of the research in progress at the Bell Laboratories in conjunction with the Western Electric Co. on lead cable sheath in an effort to develop a material that will not deteriorate under severe service conditions. WAT (5a)

Colloid Chemistry—Theoretical and Applied. Vol. III. Technological Applications. Edited by Jerome Alexander. Chemical Catalog Co., New York, 1931. Cloth, 9¼ x 6¼ inches, 655 pages. Price $10.50.

Of the 42 chapters, written by various authors, 7 relate directly to metals. Of these, one by J. Alexander deals with the colloidal state in metals and alloys, chiefly in regard to the so-called "zone of maximum colloidality," and arguing more from the analogy of glass than from metallurgical facts. The amorphous theory is accepted, metals being supposed to contain "iso-colloids." β iron is assumed to be an adsorption compound of α iron dispersed in γ iron. Martensite is called a cementite ferrosol, a colloidal dispersion of iron carbide in iron, and its hardness is taken to be due to surface forces arising from the high state of subdivision. In precipitation-hardened alloys, hardening is ascribed to these forces, not to mechanical keying of slip-planes. This chapter is not written in a very convincing style; many cases where colloidal dimensions doubtless do account for observed phenomena are mixed in with others in which it is straining the point very much to assume that colloids come into the picture. Wherever a colloidal explanation can be thought of, it is given whether it ties in with metallurgical facts or not. The chapter would have been improved by having it censored by metallurgists and about half of it omitted as pure speculation. A chapter on Colloidal Conditions in Metal Crystals, by W. Guertler translated by Jerome Strauss, is a far better statement of the colloid point of view of age-hardening phenomena. The chapter "Colloid Systems in Metallography" by C. Benedicks, defines troostite as pearlite containing cementite in colloidal dispersion, martensite as a homogeneous supersaturated solution. One by K. Honda "On the Well-Known Five Structures in Carbon Steels" classes martensite as a homogeneous solid solution phase, troostite as a colloidal dispersion. Various theories stated by Honda in numerous publications are repeated. Yap, Chu-Phay in a chapter on "The Role of Surface Energy on the Equilibria of Iron and Iron Carbide," ascribes results obtained by Wark as due to his working with a fully martensitic structure (heterogeneous with cementite colloidally dispersed in ferrite). The differences in the location of the Acm line as determined by various workers is ascribed to variations in particle size of the cementite. The author disagrees with the slip-interference theory of Jeffries and Archer. The most satisfactory of the metallurgical chapters is a very short one by U. R. Evans on "The Properties of Thin Films on Metals." The final metallurgical chapter is by J. N. Friend on "The Colloids and the Corrosion of Iron," in which Friend's ideas on this subject are reiterated. Many of the other chapters in the book deal with matters of some interest to the metallurgist, such as those on adhesion, results of X-ray researches, wetting, dispersions, suspensoids, flotation, etc. In general, these are far more clear cut, definite, understandable and acceptable than are some of the metallurgical chapters, probably because in systems that can be studied by the ultra microscope, for example, facts can be assembled in greater profusion than can be the case with the metals, which are non-transparent and where the experimental difficulties in dealing with particles of colloidal size leave much to guess-work. The lack of agreement on many points among the authors of the metallurgical chapters brings out more clearly than does any single chapter, the haziness of the colloidal concepts as applied to metallurgy. In spite of the haziness, many interesting and useful points of view are brought out. H. W. Gillett (5a)-**B**-

The Sub-Crystalline Structure of Ferrite. C. O. Bannister & W. D. Jones. *Engineering,* Vol. 131, May 29, 1931, page 707.

Abstract of paper read before the Iron and Steel Institute, London, May 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 250. LFM (5a)

The Beta to Alpha Transformation in Hot-forged Brass. Robert S. Baker (American Brass Co.). *American Institute of Mining & Metallurgical Engineers, Preprint,* 1931, 4 pages.

Direct transformation of β to α was observed in portions of a hot-forged brass containing 60.26% Cu, 37.86% Zn and 1.88% Pb. This resulted from rapid cooling in the die. This transformation prevented the brass from properly filling the mold. 1 reference. JLG (5a)

On the Adsorption of Ions Particularly of Radio Elements and Dye Stuffs on Salt-like Compounds. (Ueber die Adsorption von Ionen, insbesondere der Radio-elemente und Farbstoffe an salzartigen Verbindungen.) K. Fajans & T. Erdey-Gruz. *Zeitschrift für physikalische Chemie,* Sec. A, Vol. 158, Dec. 1931, pages 97-151.

Mainly pertains to the adsorption of ThB^{++} and of Pb^{++} on different Ag compounds. EF (5a)

The Origin of Intersticial Cementite and Its Effect Upon the Mechanical Properties of Soft Steel. (Die Entstehung von Korngrenzenzementit und sein Einfluss auf die mechanischen Eigenschaften weichen Flussstahles.) H. Kornfeld & G. Brieger. *Archiv für Eisenhüttenwessen,* Vol. 5, Dec. 1931, pages 315-322.

Report from the Research Laboratory of the United Steel Works, Dortmund. The conditions of formation of intersticial cementite were studied on sheets, 4 mm. thick, of a soft, killed open hearth steel of the following composition: C, 0.11%; Si, 0.09%; Mn, 0.41%; P, 0.01%; S, 0.03%. The steel was practically free from segregations and showed non-metallic inclusions only to a slight extent. All specimens were normalized at 910° C. for ¼ hr., then stretched in a 50 ton Amsler tensile testing machine by 5%, 10%, 15% and 20%, and then annealed at 740° C., 760° C., 780° C., 800° C., and 820° C. for ½ hr., 1 hr., and 3 hrs. After annealing, the specimens were cooled down to 600° C. with an average velocity of 55° C./hr. Yield point, tensile strength, elongation, reduction of area, notch toughness, structure and grain size were determined. The results are as follows: In accordance with the results of the investigation by A. Pomp & E. Holweg (*Mitteilungen Kaiser Wilhelm Institut,* Vol. 13, 1931, report 171, pages 1-28) it was found that, on the one hand, annealing between Ac_1 and Ac_3 is necessary to bring about the occurrence of intersticial cementite; on the other hand, the crystallization of intersticial cementite is most pronounced with the specimens that have been critically deformed, i.e. by about 15%. The values of yield point, tensile strength, elongation and reduction of area show no peculiarities except in dependence upon the degree of stretching. In considering the results of the mechanical properties individually for the various degrees of stretching, there is no pronounced effect of the annealing temperature apparent, though the values at the annealing temperature between 740° to 780° C. are somewhat lower, and also the longer times of annealing do not remarkably decrease the properties. However, there is a remarkable effect as to the degree of stretching. As to yield point and tensile strength the influence of stretching is as follows: when these properties are compared with those of specimens in normalized state. Stretching by 5% decreases the yield point by 2%, the tensile strength by 9%; stretching by 10%, decreases yield point and tensile strength by 12%; stretching by 15% decreases the yield point by 35% and the tensile strength by 16%; stretching by 20% decreases the yield point by 25% and the tensile strength by 13%. Obviously, yield point and tensile strength are essentially lowered in the range of critical, cold deformation. This effect could not be clearly established with the elongation due to larger fluctuations of the individual testing values. The reduction of area is not affected by the various treatments. The surface appearance of the specimens behaves similarly and the specimens stretched by 5% and 10% is about 30% lower than that of the normalized ones, regardless of annealing temperature and time. The notch toughness of the specimens stretched by 15 and 20% are in the average 50% and 40%, respectively, lower than in normalized state; the lowest values are attained at the annealing temperature of 760° C. In accordance with Pomp and Holweg the authors found no distinct relation between notch toughness and grain size, inasmuch as a specimen with typical intersticial cementite and a smaller grain size may have a lower notch toughness than the same material with a coarser grain but a normal pearlitic structure. When it is thus shown that intersticial cementite decreases the notch toughness it must be stated on the other hand that among the specimens with intersticial cementite, variations of its structure cause the contradiction of the established relation between grain size and notch toughness. Though intersticial cementite in combination with a coarse grain generally decreases the notch toughness, the material does not become brittle in the common sense. However, specimens with intersticial cementite show an increased tendency for brittleness through aging, as determined by stretching and subsequent aging at 200° C. in oil. This increased sensibility for aging in comparison with a normal pearlitic structure is caused, not only by a coarse grain, but actually by intersticial cementite. 10 references.

GN (5a)

Macro-Etching of Aluminum Silicon Alloys. William Hume-Rothery. *American Metal Market,* Vol. 38, Sept. 17, 1931, page 4; *Engineer,* Vol. 152, Sept. 25, 1931, page 321.

Paper presented at Institute of Metals, Zurich, Switzerland, 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 301.

LFM + DTR (5a)

Diagram of Iron-Manganese Alloys. V. N. Krivobok. *Heat Treating & Forging,* Vol. 17, Feb. 1931, pages 153-154.

An attempt was made to construct a tentative diagram of state on the basis of thermal analysis and metallographic observations and X-ray patterns. The theory that Fe-Mn alloys form a simple continuous series of solid solutions is not sustained but a much more complicated diagram (parts of which are determined) seems to result from the investigation. See also *Metals & Alloys,* Vol. 2, Aug. 1931, page 142.

Ha (5a)

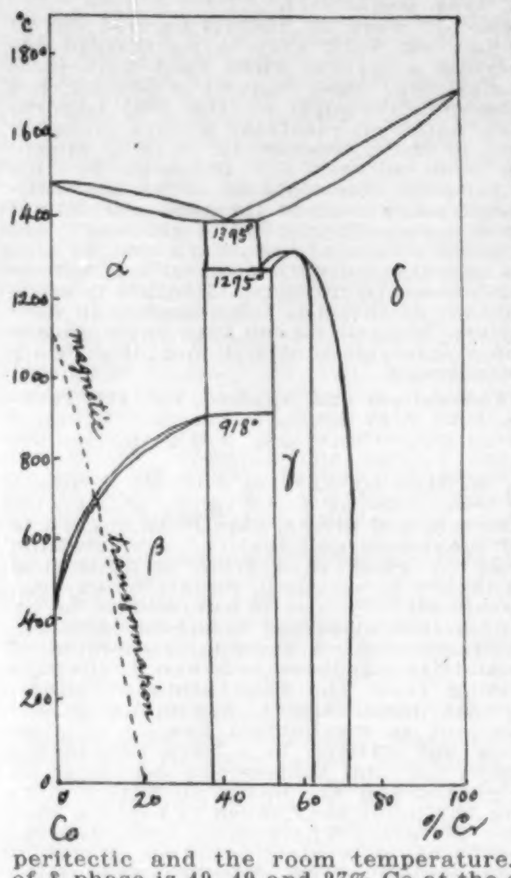
Contribution to the Thermo-Dynamics of Concentrated Solutions. I. Eutectic Systems. (Beiträge zur Thermodynamic der konzentrierten Lösungen. I. Mitteilungen: Eutektische Systeme.) E. Kordes. *Zeitschrift für physikalische Chemie,* Vol. 158, Sec. A, Dec. 1931, pages 1-34.

Kordes established a relationship between the Van't Hoff equation of freezing point lowering and the "general eutectic equation" which was empirically found by himself at an earlier date. Based on the new relationship, the dependence of the eutectic exponents on the melting point of the pure components and on the differential heat of solution in the eutectic is derived. It is shown that the position of the eutectic point in numerous binary systems can be anticipated by calculations involving the melting temperatures and the melting heat of the pure components. The evaluated eutectic is in satisfactory agreement with the actual eutectic found by experiments. Among the 22 binary constitutional diagrams considered, 7 systems with inorganic components and 12 built up by metallic compounds are met with, while the balance refers to the following binary metal systems: Al-Sn, Zn-Cd, and Sb-Pb.

EF (5a)

On the Equilibrium Diagram of the Cobalt-Chromium System. Y. Matsunaga. *Kinzoku no Kenkyu,* Japan, Oct. 1931, pages 549 to 564.

The equilibrium diagram of Co-Cr system was determined by means of thermal and magnetic analyses, microscopic examination, dilatation and electrical resistance measurements.



Results are shown in figure. In the liquid state, Co and Cr are completely miscible. In the solid state, there exist 4 phases of solid solutions α, β, γ and δ; α and β phases are solid solutions consisting mainly of Co, the former being a face centered cubic lattice and stable at higher temperature, while the latter is an hexagonal lattice and stable at lower temperatures, γ phase is a solid solution of an intermetallic compound, and δ phase a solid solution consisting mainly of Cr having body centered cubic lattice. α and δ phases form eutectic at 1395° C., 42% Cr. α and γ phases form a eutectoid at 1275° C., 51% Cr. β and γ phases form a peritectoid at 918° C., 38% Cr. The solubility limit of the α phase is 38.5, 38, and 38% Cr at the eutectic, the eutectoid and the peritectoid temperatures, respectively, while that of β phase is 38% at the peritectic and the room temperature. The solubility limit of δ phase is 49, 49 and 27% Co at the eutectic, the eutectoid, and the room temperature respectively. The existing range of γ phase is 62, 57-63, and 58-63% Cr at 1306° C., the eutectoid point and the room temperature, respectively. The magnetic transformation point of Co lowers down to the room temperature at 21% Cr. The hardness, electrical resistivity at the room temperature are also measured.

KT (5a)

Shot Gun Explosion Mystery Solved by Metallography. Oscar E. Harder (Battelle Memorial Institute). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 226-228.

The author reports the findings of a metallographic study of a hunting accident.

WLC (5a)

Martensite Crystallization in High Carbon Steels. (Die Martensitkristallisation in hochkohlenstoffhaltigen Stählen.) Heinrich Hanemann & Hans Joachim Wiester. *Archiv für das Eisenhüttenwesen,* Vol. 5, Jan. 1932, pages 377-382.

Article of the Metallographical & Metallurgical Institut der Technischen Hochschule Berlin. By means of quenching steel test samples in low melting alloys, such as Wood's metal, the homogenous austenite and the separation of martensite needles of high C steels was observed under the microscope. With the aid of systematic evaluation of the annealing operations, the beginning and course of martensite crystallization in steels of 0.83 to 1.69% C were studied in structure. The results were corroborated by magnetic measurement of 3 steels, 0.83, 1.17 and 1.34% C. Austenite is practically non-magnetic, while martensite, on the other hand, is strongly magnetic. Austenite in high C steels from below 200° C. to temperature of beginning of formation of martensite is unusually stable; at higher temperatures, however, it broke down into α-Fe (ferrite) and cementite without martensite conversion. The beginning of martensite crystallization is related to a definite temperature, which depends upon the C content. The course of this crystallization is such that temperature corresponds to an equilibrium between austenite and the η-phase. This $\gamma \rightarrow \eta$ transformation is practically independent of rate of cooling. Hence transformation of martensite is an inherently different process from transformation of austenite into ferrite and cementite; course of this formation proceeds according to its individual actions. Composition of 11 high C steels and temperatures of beginning of η-Fe separation, and magnetic intensities of 3 high C steels are given in tables. Included are diagrammatic curves showing transformation temperature against rate of cooling and effect of C content on the beginning of η-crystallization and 25 diagrams showing structure under all conditions of cooling, annealing, etc.

GN + DTR (5a)

On the Critical Anisotropic Point of Ferro-magnetic Crystals. (Ueber den kritischen Anisotropiepunkt ferro-magnetischer Kristalle.) N. S. Akulov (University of Königsberg). *Physikalische Zeitschrift,* Vol. 32, Jan. 15, 1931, pages 107-108.

The relative change of electrical resistance for a magnetic crystal under the influence of magnetization is expressed by an equation of the same form as previously given for the change in physical properties. The following law is established: if 2 curves of the relative change of electric resistance vs. magnetization derived for 2 different angles between the magnetization vector and chief axis of the crystal intersect, then the curve for any angle must also pass through this point. Data given by Webster are used for demonstrating an example.

EF (5a)

On the Verification of the Theory of Magnetization of Single Crystals. FRANCIS BITTER. *Physical Review,* Vol. 39, Jan. 1932, pages 371-375.

The paper is one presented in a Symposium on Magnetization by the American Physical Society, Sept. 1931. The theory of magnetization outlined in the other papers of this Symposium makes it possible not only to construct the magnetization curves of single crystals in their principal crystallographic directions, as has been done, but also to predict the magnetization produced by any field acting on a crystal in any direction. The procedure is briefly the following, assume the material to be made up of small regions magnetized to a given intensity, but free to orient their magnetization independently of their neighbors. The potential energy per unit volume of such a region as a function of its direction of magnetization within an unstrained crystal is then expressed in an equation set forth in the present paper for both cubic and hexagonal crystals. The scheme presented herein is capable of representing the main features of the deviation effect in crystals; that certain departures from symmetry which require further investigation are found in some materials; and that studies of the magnetization of single crystals in large fields in the neighborhood of the axes of different magnetization should supplement studies of the initial susceptibility, as both quantities depend on the distribution of magnetized regions differing only slightly in depth. It may further be concluded that fields nearly parallel to a direction of difficult magnetization will probably be found structure-sensitive.
WAT (6)

Recent Dynamic Measurements on Bridge Structures. (Neuere dynamische Messungen im Bruckenbau.) R. BERNHARD. *Maschinenbau,* Vol. 10, Dec. 3, 1931, pages 727-728.

Describes the measurements which really amount to stress (elongation) tests. The difficulties in practical determination of these measurements are outlined with relation to the data obtained from the investigation. From this follows a discussion on the preliminary results obtained, with relation to the present methods of determining dynamic influences.
MAB (6)

A Hardness Testing Machine. *Fuel Economist,* Jan. 1931, page 63.

Direct reading hardness tester in terms of standard penetration numbers. 2 types of penetrators, (1) steel ball for softer materials; (2) diamond cone for hardest steels.
DTR (6)

Hardness Tests. (Harteprüfung.) BERTOLD BUXBAUM. *Maschinenbau,* Vol. 10, Mar. 19, 1931, pages 201-204.

Discusses and criticizes the kinds of hardness tests. One does not test directly for hardness, but for the property exhibited by the five kinds of phenomena resulting from the testing. The hardness value itself is not obtained and used, but four properties, the *functions* of hardness, and a special property of material are represented.
MAB (6)

Fatigue Strength and Tensile and Rupture Strength. *Metallurgist,* June, 1930, pages 94-95.

Extended abstract of an article by W. Kuntze appearing in *Zeitschrift Verein deutscher Ingenieure,* Feb. 22, 1930. See "Calculation of Vibration Strength from Tensile Strength and Elastic Property," *Metals & Alloys,* Vol. 1, Dec. 1930, page 909.
VVK (6)

New Method For Measuring Rapidly Alternating Mechanical Forces (Neues Verfahren zur Messung schnellwechselnder mechanischer Kräfte). A. WALLICHS & H. OPITZ. *Stahl und Eisen,* Vol. 51, Nov. 26, 1931, pages 1478-1479.

The article describes a new apparatus for electrically measuring the forces occurring in cutting, turning, planing, sawing, etc. The apparatus works as follows: a measuring box filled with a solution of nitrate of lead is adjusted below the turning tool. The pressure of cutting is taken up by a diaphragm of steel, the elastic inflections of which narrow the cross-section of the liquid and thus increase its electric resistance. This resistance is measured and indicative of the pressure on the point of the tool. A special type of measuring box has been constructed for lathes where the available space is limited.
GN (6)

Tests on Cast Iron Specimens of Various Diameters. J. T. MACKENZIE. *Proceedings American Society for Testing Materials,* Vol. 31, 1931, Pt. 1, pages 160-166.

See abstract of preprint, *Metals & Alloys,* Vol. 2, Nov. 1931, page 255.
HWG (6)

The Influence of Shape in Tensile Test Pieces. A. C. VIVIAN. *Foundry Trade Journal,* Vol. 46, Jan. 28, 1932, pages 67-71.

Discusses very completely the view that when cast Fe is tested to destruction, the apparent tensile strength obtained is influenced by the shape of the test piece far more than is generally recognized. When test pieces of large diameter are broken, the comparatively low strength yielded by the test is usually attributed to weak metal in the center of the casting. It is pointed out that there is some reason to believe that when the tensile test piece is pulled, the load is transmitted to the skin of the test piece and then directed toward the center of the section by a species of shear force. Since cast Fe is not a perfectly rigid material, the longitudinal fibres at the center will not be stretched as much as the skin fibres, particularly if the specimen be relatively short and thick. Points out that if the various parts of the specimen are sufficiently long relative to their respective diameters, this shear effect is likely to be negligible, but that in the case of tensile test bars above ½" or ¾" diameter these parts are not made long enough to eliminate the shear effect and its consequent deleterious action on the apparent strength of the iron. The paper deals largely with the correlation of test results from bars of various sizes. The experiments, however, were carried out almost entirely on pieces cut from rubber sheet, the object of the tests being to exaggerate the conditions which are believed to exist within cast Fe test bars. The article is accompanied by 4 tables and 8 diagrams.
OWE (6)

Saving Money by Controlling Flange Wear. C. L. RINN. *Electric Traction,* Vol. 27, Nov. 1931, page 538.

Steel car wheel flange wear has been controlled by the Georgia Power Company, Atlanta, merely by keeping wheels mated in service. The flanges are checked in the car barn and the larger diameter wheel with the thick flange is ground until the diameter is reduced to about 1/64" smaller than its mate with the thin flange. This will create what is termed a floating condition, that is, neither flange lies heavily against the rail, thus modifying the flange wear tendency. 2 metal gages are used in the car barn inspection, one marked "attention," the other "limit." Attention gage fits over a flange that has worn 1/16", and the limit gage 1/8" less than the original or new flange thickness. When the attention gage fits over the flange it means that this wheel is tending toward a thin flange and its mate or the other wheel on the same axle should be ground at the next car inspection period (1,000 to 1,400 car miles). If the limit gage fits over the flange, its mate should be ground within a few days. The grinding is accomplished by means of a pit wheel grinder, without the expense of an automatic welder for building up flanges or heavy car wheel lathes and shop grinders. Car wheels may be used in this manner until the diameter has been down to the motor clearance limit. Diagrams of the gages are shown. Car wheels have still been in service after 180,000 miles, whereas wheels not checked in the above manner had to be replaced after 83,000 miles. Cars on this property are of the 4-motor, double-truck type weighing 38,000 lbs. with 26 in. diameter wheels.
WAT (6)

Wires, Ropes, Struts. (Fils, cables, haubans). J. POMEY. *Revue de Métallurgie,* Vol. 28, Dec. 1931, pages 673-689.

Many tests designed for reproduction of the conditions which might be present in actual practice failed to reduce the properties of airplane connecting members to the point of danger or to produce fractures encountered in actual failures. Testing must be conducted on finished articles, but much information can be gathered from the use of a special impact test machine (described) based on the principle of a small impact pendulum or hardness testing apparatus designed for use with wires (described). Tendency is to replace 0.55 C steel with 0.20-0.40 C, 0.8-2.0 Cr and 4.0-5.0 Ni stock. Wires can be checked very well for uniformity by twisting two together. Any non-uniformity will show itself by the difference in the degree of the twist.
JDG (6)

Strain Tests on Steel Plates Carrying H-Section Columns. GEO. C. PRIESTER & C. H. SANDBERG. *Engineering News Record,* Vol. 106, Mar. 19, 1931, pages 482-483.

A series of tests were made to illustrate the transmission of a load from a column through a steel plate to an elastic resisting medium. The formulas used for such problems are reviewed; the tests are described and the following conclusions are reached: for square plate, the major portion of the load from an H-column is transmitted to the plate along the flanges of the column; the contact area between the plate and its base is a function of the elastic properties of the base, the thickness of the plate and the location of the application of the load. This area is not a function of the magnitude of the load so long as the foundation is elastic.
Ha (6)

Gray-Iron and its Testing Methods. (Der Grauguss und seine Prüfmethoden.) E. PIWOWARSKY. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Nov. 27, 1931, pages 898-901.

The present methods of determining tensile strength, fluidity, bending strength, hardness, compression, shearing-stamping test, impact strength, fatigue strength, density, permeability for water, growth, electrical resistance, magnetic properties, machineability, wearing strength, are reviewed and a list of bibliographical references is added.
Ha (6)

Physical Properties of Electrically Welded Steel Tubing. H. L. WHITTEMORE, J. S. ADELSON & E. O. SEAQUIST. *Journal American Welding Society,* Vol. 9, Oct. 1930, pages 17-48.

See *Metals & Alloys,* Vol. 1, July 1930, page 629.
(6)

Stressing of Material. Conditions for the Ultimate Limit. (Anstrengung eines Werkstoffes. Bedingungen für die zulässige Grenze.) G. D. SANDEL. *Die Wärme,* Vol. 54, May 9, 1931, pages 349-350.

The writer summarizes his paper as follows, "The gradual amount of deformation is characterized as a linear magnitude. Taking an ultimate limit of the amount as the maximum of deformation for each state of stress, a new strength criterion for quasi-isotropic materials is obtained. The anticipations based on theoretical derivations are in fair agreement with actual determinations. If the following definition: 'Equivalent degrees of deformation correspond to equivalent states of stress' is taken as a basis, the ultimate limiting condition is no longer hypothesis but axiom."
EF (6)

Some Tests of Intermetallic Abrasion. H. W. SWIFT. *Engineering,* Vol. 131, June 19, 1931, pages 783-785.

In abrasion testing pressure should be uniform over the surface in contact, the speed of rubbing constant, and means should exist for measuring the amount of wear. The machine used for these tests consists of a cylindrical drum, the flat annular end of which is rubbed against the surface of the specimens under test. Three specimens are tested simultaneously. They are weighed together after every 20,000 revolutions, and the test covers normally from 250,000 to 500,000 revolutions or 350,000 to 700,000 ft. of rubbing. Results are expressed in terms of the mean depth of wear in mils per million feet of rubbing determined from the loss in weight of the specimens, and their density. The following materials were tested: nitralloy steel, gear steel, mild steel, cast iron, phosphor bronze, and "Halo." A table gives results obtained by rubbing specimens of the same material against drums of the same and different materials. In general the results show that a hard material will resist abrasion better than a soft one. Tests give indication of best combinations of materials to be used together where friction is an important factor. Comparison of results shows that for cast iron, the best mating material is nitralloy steel; with mild steel, phosphor bronze or nitralloy should give good results; with gear steel, nitralloy is best; with phosphor bronze, at lower pressures gear steel and at high pressures nitralloy.
LFM (6)

Barkhausen Effect: Orientation of Magnetization in Elementary Domains. Richard M. Bozorth. *Physical Review,* Vol. 38, Jan. 1932, pages 353-356.

Since the postulate of the elementary domain by Weiss, and the discovery of the discontinuous nature of the magnetization process by Barkhausen, there have been many investigations attempting to throw more light on the nature of the elementary regions in each of the magnetization changes as a unit. On the experimental side it is of interest to know the sizes of the domains, the extent to which the domain is localized in space, the extent to which it is "saturated" in one direction, and the orientation of its magnetization vector before and after the change. It has been found that nearly all the magnetization takes place in jumps. The evidence set forth herein indicates that the elementary domain is a region well localized in space, within the whole of which the elementary magnets reverse. The paper is one of the Symposium on Magnetization of the American Physical Society, Sept. 1931. WAT (6)

Torsional Stresses, with Plastic Shear. Erik Abt. *Engineering,* Vol. 131, June 5, 1931, page 721.

Short article describing method suitable for solving torsional problems where time is not available for research and complicated investigations. A flexible membrane is stretched across an opening of a form similar to a twisted shaft which is distended by constant pressure. Stresses in any point of the cross section can be determined by measuring the steepest gradient of the distended surface at this point. The volume enclosed between the membrane and the base is a measure of the twisting moment. Maximum shear stress is assumed to be constant when plasticity develops. Diagrams are given illustrating this method of testing. LFM (6)

Magnetization and the Magneto-Caloric Effect. Francis Bitter. *Physical Review,* Vol. 38, Aug. 1931, pages 528-548.

The magneto-caloric effect is defined as the reversible evolution of heat accompanying a change in the magnetization of a ferromagnetic substance, in contradistinction to the irreversible evolution of heat referred to as hysteresis. In two previous notes it was suggested that ferromagnetic substances are spontaneously magnetized in small regions containing roughly 10^5 atoms. Here the following points are briefly discussed: (1) the formation of these units called blocks; (2) the interaction of these blocks to form clusters, which probably give rise to the Barkhausen effect; (3) the changes that take place in the neighborhood of the Curie point; (4) the changes that take place during magnetization. The essential results of the above discussion are that a sudden change in the applied field will produce changes in the energy of every block. The new energy distribution is not stable, and equilibrium is reached by means of an adiabatic diffusion process resulting from thermal agitation, which brings with it a reversible change in temperature. The mechanism is illustrated by means of a simple model. If the strains due to magnetostriction, stray internal fields, and the effect of crystal orientation are neglected, the magneto-caloric effect is amenable to calculation. It is pointed out under what experimental conditions such neglects are justifiable. A detailed comparison is undertaken between experimental observations of the magneto-caloric effect in nickel in high fields and the theoretical predictions based on the assumption that the effect is due to processes involving Weiss' molecular field. The agreement is satisfactory at temperatures not too near the Curie point. Too little is known about the magnetic transformation to permit a quantitative analysis to be made. Akulov's static theory of the magnetization curve of single crystals predicts the absence of a magneto-caloric effect due to rotation of the regions of spontaneous magnetization, i. e., the work done in rotating the magnetization of such a region is equal to its change in potential energy, and therefore there can be no change in heat content. Experimentally this relation is approximately satisfied for Fe and Ni, and less well for Co. If, in the case of Co, the discrepancy is real, a magneto-caloric effect of the order of 0.03° C. is to be expected. The magnetization curves for crystals of Ni and Co on the basis of Akulov's theory are calculated. It is pointed out that experiments on the magneto-caloric effect of single crystals would be of great help in determining the mechanism of magnetization. WAT (6)

Effects of Bending Wire Rope. Frederick C. Carstarphen. *Proceedings American Society Civil Engineers,* Vol. 57, Dec. 1931, pages 1439-1466.

An ever-present suspicion appears in the discussion of wire rope to the effect that the popular formulas for the estimation of the loss of strength due to bending may not be consistent with experiment. This can be settled only by holding the problem up to engineering and analytical scrutiny. This paper is a start along this path. New and more comprehensive formulas are presented, which may serve a useful purpose in bringing to light data and analyses of the problem that have not been published by those who have given their attention to the subject. Wire rope is one of the most used, and most abused, commodities of industry. Therefore, all of its properties should be known, to the end that the public and the wire rope manufacturer may agree upon the increase in its costs, if necessary, to provide for more safeguards in the selection of materials and in the process of manufacture, so that its performance may be predicted for a properly supervised service. Formulas are developed for the bending stresses in various sizes of wire rope while being bent around various sizes of sheaves. Equations are also set forth on the loss of strength as result of such bending. Much of the paper is mathematical. It is shown that a systematic grouping of wires into helices bent about a core may be regarded as having the properties of a yielding foundation. Calculations for loss of strength due to bending wire rope, that are made upon the assumption of pure bending, lead to results that are not satisfactory. Treating the subject from the view point that each strand of the rope is an open-coiled helical "spring" in tension while being bent leads to more satisfactory results. WAT (6)

The Hardening of Metals by Rotating Magnetic Fields. Edward G. Herbert. *World Power,* Vol. 16, Oct. 1931, pages 274-277; *Revue General de l'Electricite,* Vol. 30, July 4, 1931, pages 12-16; *Heat Treating & Forging,* Vol. 17, Dec. 1931, pages 1118-1120.

Experiments are described in which the hardness of various metals is increased by rotating them in a magnetic field. The hardness changes described are believed to indicate a rearrangement of atoms in the space lattice or a change in the atoms themselves, but no explanation is attempted. The time element enters as an important factor into all results produced by the rotating field. The hardness changes are sometimes very rapid, and in a hard steel freshly treated they may be observed from minute to minute. The hardness induced by magnetic treatment is known to persist for months and there is no reason to believe that it is other than permanent, though no systematic investigation has yet been carried over long periods of time. As no metal subjected to the treatment has failed to respond, the possibility must be contemplated that these phenomena are common to all metals. The temperature at which the magnetic treatment is applied has a marked effect on the resulting hardness changes. In the case of hard steel, the treatment is less effective at room temperature than at 100° C., but the latter temperature was arbitrarily chosen and further experiments may show a higher or lower temperature to be more effective. An increase of hardness, such as would indicate an increase of 20% in the tensile strength, has been induced in a soft steel by a single rotation at room temperature; the maximum hardness is attained after 8 hrs. The practical application of the magnetic treatment to hard tool steels is obvious. An increase in hardness from 725 to 820 Brinell was induced in high speed steel by a single turn in the magnetic field, occupying about one minute and applied at a temperature of 100° C. In the non-magnetic metals, the hardness changes produced have been relatively slight. The theoretical importance of these phenomena is believed to be great, but further experiments will be necessary to establish any definite facts. MS+HA+WAT (6)

Material Testing. (Stoffprüfung.) Ernst Lehr. *Zeitschrift Verein Deutscher Ingenieure,* Vol. 75, Nov. 14, 1931, pages 1401-1409.

The present status of material testing is reviewed; the testing methods and their value are discussed for cast-iron, metals at high temperatures, notch-impact tests, vibration strength, metallography. Non-metallic inorganic materials treated are: rocks, cement, concrete, and reinforced concrete; organic materials: asphaltum, wood, and solid fuels. The calibration of testing machines are discussed and values for their accuracy proposed for instance for tensile test machines 1%, hardness testers 2%, vibration testing machines 3-5%. Non-ambiguous definitions are given for elasticity, plasticity, toughness, brittleness, hardness and machineability. Finally, the determination of grain size and distribution of grains in mixtures of loose bodies is discussed and an apparatus for testing colloidal distribution described. 26 references. Ha (6)

The Theory of Wear. (Ueber die Abnutzungstheorie.) H. Friedrich. *Maschinenbau,* Vol. 9, Dec. 1930, pages 781-782.

This is a completion of a paper on the same subject by the author published in *Maschinenbau,* Vol. 9, 1930, page 129. It discusses the further systematizing of the theory, and the results of wear tests. MAB (6)

Influence of Notches on Bars Subjected to Bending Stress. (Kerbwirkung an Biegestäben.) G. Fischer. VDI—Verlag, Berlin, 1932. Paper 6x8½ inches, 164 pages. Price 6.35 RM.

Static bending tests, with the bending moment applied by two-point loading, were made on steel specimens with various notches. The steel used gave 195 Brinell, 92,500-98,000 lbs./in.^{2} tensile, 13 to 15½% elongation, 32 to 45% reduction of area—analysis not given. The specimens were 16.5 cm. long, supported on 100 cm. centers and loaded from above with the loading points 40 cm. apart. The rectangular bar was 11 cm. high and 2½ cm. thick. The notches varied in radius and depth and the Mesnager or Charpy type of notch, like that drilled and saw-cut in an impact bar, and the 60° sharp V or Izod notch were included. The tests were made in static loading. Sensitive strain gages were designed and used to measure the deformation along a line tangent to the base of the notch (parallel to the face of the bar) and normal to this line, at the notch. With these measurements and the use of scribed reference lines, the deformation under load and consequently the distribution of stress, were determined.

The results are expressed in many graphs showing stress distribution, and in those showing the notch coefficient plotted against radius of notch, its depth, or in case of a V notch, its angle. These last are finally assembled in a solid diagram. The Mesnager notch increased the stress something like 3 times, a 60° V "sharp" notch as it would normally be machined, something like 6 to 7 times. Cracks or notches with really sharp bases are calculated to increase the stress 9 to 10 times, although in theory a perfectly sharp notch would make the stress infinite. No tests were made in impact or in repeated bending. H. W. Gillett (6)-B-

Strain and Diamagnetic Susceptibility. H. E. Banta. *Physical Review,* Vol. 37, Mar. 1931, pages 634-637.

The magnetic susceptibility of Cu and Ag has been measured by the Gouy method before and after various annealing treatments. Also, the susceptibility has been measured before and after straining specimens beyond the elastic limit, the strains being either twists or stretches. The susceptibilities are found to be increased by as much as 20% for Cu and 3% for Ag by annealing at red heat for 15 minutes in an atmosphere of CO_2. This increase is probably due to release of occluded gases or to oxidation or recombination of impurities. Straining the specimens beyond the elastic limit is found to produce no measurable change of susceptibility. Francis Bitter has observed a large effect due to straining these metals beyond the elastic limit. The reason for Bitter's results is not clear, but it is pointed out that no effect is to be expected in Cu, at least, because crystals of this metal are isotropic magnetically and have no observed magnetostriction. WAT (6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Fatigue Testing on Patented and Drawn Steel Wire (Ermüdungsversuche mit patentiertem und gezogenem Stahldraht). A. Lindeberg. *Stahl und Eisen,* Vol. 51, Dec. 17, 1931, page 1573.

In continuing the investigation by A. Pomp and C. H. Duckwitz, *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, 1931, report 175, pages 79-91; *Stahl und Eisen,* Vol. 51, May 14, 1931, pages 620-622, the author briefly reports the results of fatigue tests on ropes which have been processed from wires tested in the above investigation. The rope fatigue tests show that in using common patenting temperatures (furnace temperature 1000° C., lead temperature 550° C.), the best results are obtained with wires of low carbon content (C: 0.43%) and drawn in 6 to 8 drafts with a total reduction of 80-90%. The results, furthermore, indicate that neither fatigue tests nor bending tests of the original wires decide the behavior of the rope in the rope fatigue testing machine. However, the number of twists which the wires stood in testing shows a relation to the results on the rope fatigue testing machine. GN (6f)

Influence of Water Composition on Stress Corrosion. D. J. McAdam, Jr. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 259-278, 13 references, 6 figures.

The effects of corrosion by distilled and by carbonate water in corrosion fatigue tests are discussed. The total damage on some steels at high stress and low cycle frequency may be worse with distilled water than with carbonate water and of 2 metals in the same water, the one that would normally be rated as the poorer in corrosion resistance may show up the better. The data are presented in various types of diagrams, for an understanding of which it is advisable that the many previous publications of the author on this general subject be consulted. HWG (6f)

Tensile Tests and the Fatigue Limit. *Metallurgist,* Mar. 28, 1930, pages 34-35.

This article summarizes a number of formulae for this relation proposed by Striebeck, Herold, and others and comparisons are made with the results of fatigue tests on steel. The results of the investigation can be summarized by the statement that while it is possible to calculate mean values of the fatigue limit from the tensile properties—provided the effect of surface roughness is eliminated as far as possible by grinding—the value so calculated may differ appreciably from measured values, and so can only be regarded as approximate. It would then appear that the endurance test cannot be replaced by a different type of test. (6f)

Endurance of Steel with Rolling Skin, and with and without Holes, and Endurance of Riveted and Welded Structures (Dauerfestigkeit von Stahlen mit Walzhaut von Niet- und Schweissverbindungen). O. Graf. VDI-Verlag, Berlin, 1931. Paper, 6 x 8½ inches, 42 pages. Price 7 RM.

Large flat specimens of structural steels bored with a hole, as for riveting, and with the rolling skin left on, were tested under repeated stress in Amsler tensile testing machines provided with pulsators. Runs were made to 2 million cycles, over a range of stress varying from a given initial tension to a higher tension. The endurance limit of the specimens with holes averaged 61% of that without holes. The endurance ratio of such specimens varied considerably with different steels, and the endurance limit of the stronger steels (80,000 tensile) is not always higher than that of the soft steel (55,000 tensile). No punched holes were used. The range of stress was varied and since the upper limit of usefulness is fixed by the yield point, the high strength steels will stand up better at high initial loads. The effect of the rolling skin was studied on bars without holes. A smooth skin gave results only a few percent below those of carefully polished specimens, but one lot which had fine cracks on the surface had very low endurance limit. Riveted specimens with 3 rivets in each lap gave endurance limits above those of specimens of the same steel tested with one rivet hole but no rivet. Tests were also made on the behavior of rivets. Welded specimens were tested by repeated bending and in repeated tension. In the latter the welded copperchromium structural steel gave a much higher endurance range than ordinary soft steel. Welding is not recommended for structures subject to repeated stress.
H. W. Gillett (6f)-B-

Fatigue Properties of Welds. R. A. Weinman (General Electric Co.). *Journal of the American Welding Society,* Vol. 10, Oct. 1931, pages 12-18; Dec. 1931, pages 23-24.

Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Results of fatigue tests of atomic hydrogen welds and weld metal indicate that the behavior of welded structures under fatigue stress does not differ from that of forged and rolled metal. All weld metal specimens built up of mild steel and steels containing small amounts of Cr, Ni and Si showed endurance limits between 22,000 and 30,000 lbs./in.^{2}. Welded samples of mild steel plate varied in endurance limit from 18,000 to 25,000 lbs./in.^{2}; all failures take place outside the weld. Similar specimens made in high tensile strength steel showed endurance limits of 18,000 to 25,000 lbs./in.^{2} and the ratio of endurance limit to tensile strength ranges from 0.3 to 0.4; these all fail through the weld metal. Data is given on hardness of the welds and parent metal and chemical composition of welds. TEJ (6f)

Effect of Surface on the Fatigue Resistance of Spring Steels. G. A. Hankins & M. L. Becker. *Iron & Coal Trades Review,* Vol. 123, Nov. 6, 1931, pages 698-699.

This contains some additional discussion on the subject dealing with changes of the crystalline structure and the magnitude of the decarburized area and cracks. The condition of the surface before the spring is made is of importance and should be ascertained. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 306. Ha (6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Preparing Aluminum Alloy Die Castings for Plating. W. E. Warner. *Canadian Machinery,* Vol. 42, Oct. 15, 1931, page 34.

Die castings of aluminum alloy can be satisfactorily plated, provided the surface is first well prepared. The casting should first be cleaned in an alkali bath and rinsed in water. The piece should then be cleaned in a bath consisting of 3 parts of concentrated nitric acid and one part of hydrochloric acid. 10-30 secs. is sufficient to etch the surface so the plating will readily adhere. The actual plating is very similar to plating zinc die castings; the same solutions often are used. Nickel plating is the most satisfactory, and it is usually desirable where other plating is to be employed to first plate with nickel, then deposit the second plate on top of the nickel. By this means any plating can be deposited. The initial plating of nickel has also the advantage that the outer plating need not be so thick as would otherwise be necessary. WAT (7a)

Electroplating Aluminum and Its Alloys. *Electrical Manufacturing,* Vol. 8, Sept. 1931, pages 26-28.

This article developed from material published in a booklet issued by the Aluminum Co. of America, describes how Cr and Zn can be readily plated directly on smooth Al. There is a mistaken idea that Al is a difficult metal upon which to plate. Actually it is as easy to plate as other metals, but does require special methods. A good cleaner has the following constitutents: sodium carbonate (Na_2CO_3) 1 to 3 oz./gal., trisodium phosphate (Na_3PO_4) 1 to 3 oz./gal. Cr can be readily applied directly to Al from an ordinary Cr bath at about twice the usual current density used for plating Ni, requiring for cleaning only a short dip in the alkaline cleaner mentioned above. Zn can be plated directly on a smooth surface of Al, by cleaning in the above solution, rinsing, and dipping for 60 secs. in an acid cleaner. A shorter time produces poor adhesion. The Zn plating bath which has been found to be most suitable for a preliminary "flash" coating is as follows: zinc cyanide $Zn(CN)_2$ 4 oz./gal., sodium cyanide NaCN, 4 oz./gal., peptone ⅛ oz./gal. This solution is used at a current density of from 1-5 amperes/ft.^{2} for from 1-10 minutes. Plating is continued in any plating bath which may be used over Zn. WAT (7a)

How Should Incorrect Working of the Silver Plating Bath be Remedied? (Wie vermeidet man Fehler und Störungen beim Versilbern?) Hans Hornauer. *Deutsche Goldschmiede-Zeitung,* Vol. 34, Aug. 15, 1931, page 350.

Detailed discussions for correcting poor functioning of the plating bath. JLG (7a)

Are there Nickel Deposits Absolutely Free of Pores? (Gibtes absolut porenfreie Nickelniederschläge?) G. Elssner. *Oberflächentechnik,* Vol. 8, Dec. 15, 1931, pages 257-260.

Photomicrographs illustrate a few methods of nickel plating of the Langbein-Pfannhauser Works which give reliable deposits if they are at least 0.01 mm. thick Ha (7a)

Plating of Aluminum for Protection. H. C. Cocks. *Chemical Age,* London, Vol. 22, May 24, 1930, pages 485-486.

The results obtained with deposits from sulphate and cyanide zinc baths are given and the difficulties in the preparation of metal prior to plating owing to the necessity for removal of natural oxide film are outlined. The difficulties of a suitable plating solution owing to high reactivity of Al, especially in alkaline solutions and the difficulties of obtaining good adhesion of deposit to the basis metal are noted. This is an abstract of a paper presented before the Electroplaters' and Depositors' Technical Society. See *Metals & Alloys,* Vol. 2, Feb. 1931, page 38. VVK (7a)

Investigations on Production and Properties of Coatings of Chromium, Tungsten and Nickel (Untersuchungen über Herstellung und Eigenschaften von Chrom-, Wolfram- und Nickelüberzügen.) W. H. Creutzfeldt. *Stahl und Eisen,* Vol. 51, Dec. 10, 1931, pages 1542-1543.

The paper reviews the following publications: G. Fuseya & K. Sasaki, *Transactions American Electrochemical Society,* Vol. 59, 1931, pages 445-460; K. Sasaki & S. Sekito, *Transactions American Electrochemical Society,* Vol. 59, 1931, pages 437-444; J. W. Cuthbertson, *Transactions American Electrochemical Society,* Vol. 59, 1931, pages 401-428; C. G. Fink & F. L. Jones, *Transactions American Electrochemical Society,* Vol. 59, 1931, pages 461-481; L. C. Pan, *Transactions American Electrochemical Society,* Vol. 59, 1931, pages 385-392. GN (7a)

Elements of the Chemistry and Physics of Electroplating. R. J. Piersol. *Metal Cleaning & Finishing,* Vol. 3, Feb. 1931, pages 119-126.

The principles of molecular compounds, chemical reactions, electrolytic reactions and solution pressure are explained.
Ha (7a)

Porosity of Electro-Chromium Plating. *Iron & Coal Trades Review,* Vol. 123, Dec. 25, 1931, page 979.

Review of work done by the U. S. Bureau of Standards on measuring and detecting porosity of Cr coatings and the factors causing it. For common conditions of deposition, the minimum porosity is obtained with a thickness of about 0.00002 in. If the deposits are made at 65° C. instead of as usual at 45° C. the deposits are less porous. The least porous coatings are produced on Ni which is, therefore, generally applied as an intermediary coating on other materials.
Ha (7a)

Rhodium Plating Process. *Brass World,* Vol. 27, Dec. 1931, page 254.

The H. A. Wilson Co. is marketing a rhodium plating process and equipment for operating it. The process is applicable to the plating of jewelry, silverware and similar articles. Rh is impervious to corrosion and produces a permanently white, hard plate. WHB (7a)

Renewals by Electro-Deposition. *Engineering,* Vol. 131, May 22, 1931, page 676.

Editorial briefly commenting on paper entitled "The Effect of Surface Conditions and Electro-deposited Metals on the Resistance of Materials to Repeated Stresses" by R. H. D. Barklie and H. J. Davies read before the Institution of Mechanical Engineers. LFM (7a)

Electroplating, Polishing and Lacquering of Metals. (Galvanizzazione o Galvanostegie, pulitura e verniciatura dei metalli.) F. WERTH. 5th edition. Ulrico Hoepli, Milan, 1930. Cloth, 4¼ x 6 inches, 812 pages. Price 38 lire.

A rather complete handbook, written primarily from the practical point of view. Many of the illustrations are crude woodcuts from earlier editions. There was a second edition in 1907. Some more modern information is included, such as that on chromium plating, but in general, it is old, of the cook-book type, and not necessarily reliable. It is stated that the roof of the "new" City Hall at Philadelphia is plated with aluminum and that this large scale experiment proves the practical possibility of depositing aluminum from aqueous solutions! There are no literature references, but an alphabetical index is supplied. H. W. Gillett (7a)-B-

Electrodeposited Metal Foils. H. KERSTEN. *Review Scientific Instruments,* Vol. 2, Oct. 1931, pages 649-653.

Metal foils may be produced electrolytically by making use of the fact that electrodeposits do not adhere well to polished stainless steel. An apparatus, methods and plating baths for this purpose are described. Solutions for deposition of Co, Ni, Cu, Ag, Cd, Sn, Au and brass are given. Ha (7a)

New Cadmium Plating Process. *Brass World,* Vol. 27, Dec. 1931, page 256.

"Cadalux" is a new Cd plating process developed and offered by the Hanson-Van Winkle-Munning Co. The claims for it are: a very bright Cd finish, an exceptionally homogeneous and closegrained crystalline structure, excellent throwing power and a very accurate and simple method of solution control. "Nitri-Brite Dip" is a finishing process applicable to articles plated with "Cadalux." It is an acid treatment providing an extremely high additional lustre, which eliminates the necessity of buffing or scratch-brushing with the attendant reduction in susceptibility of the plated surface to finger marks, stains or other discolorations due to handling. WHB (7a)

Nickel Plating Practice Abroad. *Brass World,* Vol. 27, Dec. 1931, pages 251-254.

An abstract of a paper by W. T. Griffiths (Mond Nickel Co. Ltd.) and read before the Electro Platers' & Depositors' Technical Society. Methods of pickling and plating are discussed, as employed at a number of plants in the United States, France and Germany. WHB (7a)

The Electrolytic Production of Seamless Metal Tubes. (Die Herstellung nahtloser Metallrohre auf elektrolytischen Wege.) *Oberflächentechnik,* Vol. 9, Jan. 5, 1932, pages 1-2.

Electrolytic production of seamless pipes has been feasible so far only for comparatively short lengths; the metal was deposited, in the desired thickness, on a rotating core serving as cathode. A new method by Prof. Billiter permits a continuous production of pipes of any diameter. For pipes of 1 to 30 mm. inner diameter the process is the following: a core of Cr steel or an Fe-Si alloy is placed vertically in the electrolytic bath touching the bottom with one end and serves as cathode for the deposition of the metal. At the start, a piece of tube fitting exactly on this core and long enough to protrude from the bath is placed on the core so that it covers only a small part of it. The pipe is made the cathode, the metal is then deposited on the pipe as well as on uncovered part of the core. As soon as the deposition has reached a certain thickness the pipe and with it the thin metal cylinder deposited on the core is raised somewhat so that again a part of the core is uncovered. Metal is now again deposited and so the process goes on. In this manner a seamless tube is made with a thickness increasing step by step from the bottom to the surface of the bath. The interior of this tube is entirely smooth, the exterior shows marks corresponding to the steps by which the pipe was lifted. This method has been tried out for Cu, Fe and Zn tubes. A drawback is the slow production, about 8 cm. tube per hour. This can be increased by a modification to about 80 cm. in one hour by a horizontal arrangement of a hollow cathode. A Cu tube showed a tensile strength of 30 kg./mm.^{2}, elongation of 40% and elastic limit of 18 kg./mm.^{2} The greatest advantages of tubes produced in this manner is the absolute lack of any surface defects which are always present in rolled tubes. This process is said to be particularly suitable for Ni tubes which can be made only with difficulty and at greater cost in other ways. Ha (7a)

New Electrodeposition of Alloys (Neue galvanische Metall-Legierungen). M. WILMER. *Oberflächentechnik,* Vol. 8, Nov. 3, 1931, pages 225-226; Dec. 1, 1931, page 246.

The conditions under which an electrodeposition of alloys can be obtained are discussed. The main factors for the composition of the deposit are the ratio of the metals in the bath, the temperature and the current density. Experimental curves show the change in deposited ratio of Cu and Ni. With increasing temperature, the deposition of Cu increases. A greater influence is exerted by the current density; low densities favor, in all ratios, the deposition of Cu. More recent investigations were made with Ni-Cd alloys, Ni-Fe, Ni-Co; an alloy of 20-30% Co and 80-70% Ni has a pure white color which is obtained by no other electro deposited metal except Ag. An alloy with 25% Co has the hardness of the pure Co deposit. In conclusion, a Ag-Cd alloy is discussed. It is distinguished by its low tarnishing property, especially against atmospheric compounds of S. These alloys assume a greenish appearance like pure Cd, while Ag becomes entirely black. The characteristic curves for all these alloys are given. Ha (7a)

Current Density in Chromium Plating. R. J. PIERSOL. *Metal Cleaning & Finishing,* Vol. 3, Apr. 1931, pages 327-332.

The electrical properties of electrolytes and the magnetic effects in the latter are explained. A diagram is given for the determination of the required voltage for a given current density. Ha (7a)

Historical Survey of Chromium Plating. R. J. PIERSOL. *Metal Cleaning & Finishing,* Vol. 3, Jan. 1931, pages 29-34.

The development from Volta up to 1923 when the Sargent bath made chromium plating a commercial proposition is described. Ha (7a)

The Electrodeposition of Cadmium. (La cadmiatura elettrolitica). F. PIETRAFESA & C. LUCIANI. *La Metallurgia Italiana,* Vol. 24, Jan. 1932, pages 1-9.

The effect was studied of varying the concentration of Cd, sodium cyanide, sodium hydroxide, sodium carbonate and of additions of sodium sulphate, ammonium chloride, mannite, glucose, starch, dextrin, agar-agar, tannin, methylene blue, sodium sulphoricinate, green soap, phenol, licorice and gelatine. The presence of small amounts of Cu, Ag, Mg, Ca, Zn, Hg, Al, As, Bi, Cr, Mn, Fe, Co or Ni in baths containing 2 g./liter of gelatine, normal in cadmium and twice normal in free cyanide, did not affect the Cd deposit, while Sn, Pb and Sb were harmful. The reflectivity of the deposits with gelatine was measured with a Lummer-Brodhun photometer. Cathodic efficiency depends chiefly on concentration of Cd ion, secondarily on that of ions of alkaline metals. Anodic efficiency depends chiefly on the specific effect of the cyanogen ion. Anodic polarization decreases as cyanogen ion concentration increases. Concentration of cadmium ions, and to a smaller degree, of that of alkaline metal ions, controls the character of the deposit. Of the addition agents tried, gelatine is best, but its influence is only temporary. Gray deposits instead of bright ones are obtained when the effect of the gelatine is exhausted. This work has led up to a commercial bath, which will be described in a later communication. 15 references. HWG (7a)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Pure Tinning—A Finish For Hollow-Ware. C. EVESON. *Sheet Metal Industries,* Vol. 5, Aug. 1931, pages 265-268.

A pure tinning unit, called a stack, is described and a detailed description of the tinning of an article is given. There are 5 pots in a stack, namely: (1) thick fat—to cover (2); (2) bulk supply of tin held at about 370° C; (3) pure tin —articles are cleaned in this pot after being rough tinned; (4) pure melted Russian fat—to remove surplus tin; (5) listing pot—a small pot for finishing handles and removing drips. AWM (8)

Galvanizing vs. Rust. *Gas Journal,* Vol. 194, June 24, 1931, page 939.

Review of booklet recently published by Messrs. G. A. Harvey & Co., Ltd., dealing with the cause and prevention of rust and corrosion in iron and steel. The pamphlet describes the "Harco" hot galvanizing process, by which the Zn is definitely alloyed with the surface of the Fe. This coating is composite in character and really consists of several layers merging one into the other, there being no really sharp boundary between the Fe surface and the pure Zn. MAB (8)

Vibration of Dross Affords Higher Zinc Recovery. W. G. IMHOFF. *Steel,* Vol. 88, May 14, 1931, page 41-42.

The amount of Zn which can be recovered from the dross of the hot-galvanizing process can be materially increased by using a vibrator to shake the molten Zn from between the crystals immediately after the scoop has been raised to the surface. The method is described in detail. Ha (8)

Coatings by Aluminum (Der Anstrich aus Aluminium). H. KALPERS. *Dinglers Polytechnisches Journal,* Vol. 345, Apr. 1930, pages 64-67.

The coating technique with Al-powder is reviewed. EF (8)

Mottled Tinplates. J. C. JONES. (University College, Swansea). *Sheet Metal Industries,* Vol. 5, Oct. 1931, pages 408-419.

Includes discussion. The article presents work done in determining the effect of the steel used and of the flux in causing mottled tinplate. The author concludes that (1) the steel base has an effect and is of the opinion that Bessemer steels do not produce mottle (there is some question about the history of the steel, however), and (2) that the use of clean, active flux is necessary. See also *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 12. AWM (8)

Top-Fired Galvanizing Pot Effects Saving in Fuel. W. G. GUDE. *Steel,* Vol. 88, May 28, 1931, pages 36-38.

Description of a gas-fired galvanizing pot. Ha (8)

Centrifugal Process Meets Demand for High-Quality Galvanizing. K. P. ROLSTON. *Steel,* Vol. 88, Apr. 2, 1931, pages 39-42; Apr. 16, pages 39-41; Apr. 30, pages 35-38.

Extracting excess Zn from the surface of small galvanized articles is facilitated by centrifugal means. The different methods, equipment, and the precautions for minimizing the formation of dross are described. Ha (8)

The Spray-Sherardizing Rust-Proofing Process. *Engineering,* Vol. 131, June 5, 1931, page 750.

After brief description of the ordinary dry-vapor galvanizing or Sherardizing process, the new Spray-Sherardizing or Spray-Rust proofing process is described. It is used for coating structural steel after erection is complete. It consists of first coating the surface with a bright-green bitumen-base paint, then applying zinc dust before the paint has completely dried. The process is no more expensive than ordinary paint and is two or three times more durable. LFM (8)

The Development of the Metallic Spraying Process according to Schoop (Werdegang des Metallspritzverfahrens nach Schoop). A. SALMONY. *Dinglers Polytechnisches Journal,* Vol. 345, May 1930, pages 70-71.

The 20 years' history of Schoop's metal spray process is traced. EF (8)

Surface Treatment of Aluminum and Its Alloys. A Survey of Modern Practice. *Chemical Age,* Vol. 25, *Monthly Metallurgical Section,* July 4, 1931, pages 1-2; Aug. 1, 1931, pages 7-8.

A review covering metallic coatings for Al surface coatings by chemical treatment, electroplating and anodic oxidation. VVK (8)

Nickel-Clad Steel Affords Noncorrosive Surface. W. G. HUMPTON, F. P. HUSTON & R. J. MCKAY. *Steel,* Vol. 88, June 4, 1931, pages 44-50.

See *Metals & Alloys,* Vol. 2, Nov. 1931, page 260. Ha (8)

INDUSTRIAL USES & APPLICATIONS (9)

Aluminum in the Racing Automobile. *Metal Industry*, N. Y., Vol. 29, Sept. 1931, page 379.

Compositions and uses are given of 4 Al alloys used in the racing car "Blue Bird," which established the world record speed for automobiles. PRK (9)

Mercury Vapor Turbines. *Electrician*, Vol. 106, June 19, 1931, pages 908-909.

20,000-kw. units are being constructed for the General Electric Co. and as an extension for the Public Service Electric & Gas Co. A 7500-kw. steam turbo-generator is also included in this extension. These mercury vapor sets will have twice the capacity of the original combined mercury and steam set at the South Meadow Station of the Hartford (Conn.) Electric Light Co. The performance of the latter installation is reviewed. WHB (9)

Aluminum As An Insulating Material. *Fuel Economist*, May 1931, pages 265-267.

Information given for the use of "Alfol," insulating material made from Al foil. Chief and most obvious characteristic is its light weight, adding only 3 oz./ft.^{2} to the weight of a plant. In case of repairs to the plant insulation, the whole of the insulation may be readily renewed and replaced, a real economic advantage. With 4.49 in. diameter test pipe and 2 in. of Alfol insulation, pipe temperature 800° F., the heat lost per °F. difference of temperature in B. t. u./ft.^{2}/hr. was 0.366, or an efficiency of 95%. This material may easily be crumpled. Illustrations of plant installations with Alfol, and heat loss charts are given. DTR (9)

Pewter Ware. *Metal Industry*, London, Vol. 39, July 31, 1931, pages 99-101.

Modern pewter is free from Pb and contains 92.96% Sn with Sb and Cu. The metal is more suitable for individual craftmanship than mass production. PRK (9)

Modern High-Pressure Gages make Use of Special Steels. H. R. Simonds. *Steel*, Vol. 88, Apr. 9, 1931, pages 39-40, 53.

A Cr-Mo steel is used for the spring and nitralloy steel for the movement of the gages. Ha (9)

Die Castings Make Possible New and Redesigned Products. G. M. Rollason (U. S. Aluminum Co.). *Iron Age*, Vol. 128, Nov. 15, 1931, pages 1178-1181.

Die castings play an important part in the construction of new products, due to the attention paid to fabricating costs of dies. Pb, Sn, Zn and Al base alloys are used for die casting. Various products which are made are described. Economies are found in the elimination of machining and finishing operations. Many industries use die castings. VSP (9)

Utilization of Schoop's Metallic Spray Method in Electro-Medicine (Das Schoopsche Metallspritzverfahren im Dienst der Elektro-Medizin). M. U. Schoop & J. von Riess. *Umschau*, Vol. 35, June 6, 1931, pages 459-462.

Textile fabric covered by a metallic spray of Zn is used for flexible electrodes in dia-thermal therapy. 11 illustrations. EF (9)

Standardization of Precision Steel Tubing. (Normung der Präzisionsstahlrohre.) C. Roubaud. *Maschinenbau*, Vol. 10, Mar. 19, 1931, page 210.

Deals with the cold drawn ingot steel tubing which is used in power plants, in aircraft and by railroads, and for which the German Committee on Standards has issued standard specifications. MAB (9)

Turbine Blades Offer New Field for Alloy Steels. H. R. Simonds. *Iron Trade Review*, Vol. 86, April 10, 1930, pages 59-62.

Describes manufacture of blades at Philadelphia works of the Westinghouse Electric & Manufacturing Co. Material commonly used for reaction blades consists of 5% Mn and 95% Cu. Where temperatures are too high, pure Ni has been used. Special alloy steels are being used for certain types. A steel containing 0.05-0.10% C, 0.30-0.50% Mn, 0.10-0.25% Si, and 4.50-5.50% Ni is used for impulse blades. Corrosion resisting steel used has 0.07-0.12% C, 0.30-0.60% Mn, max. 0.03% S and P each, max. 0.35% Si, 11.50-12.50% Cr, and max. 0.60% Ni. Forged blades are made from bars of either the corrosion-resisting or Ni steels. After forging, the blades are heated in a salt bath of No. 130 Lavite to 1750° F., quenched in circulating oil at room temperature, and drawn at 1200° F. in a salt bath of No. 110 Lavite. To eliminate scale, blades are pickled several times. Small sizes of blades are made from specially rolled shapes. MS (9)

Recent Progress on Aluminum Alloys Used in Ship Building (Neuere Fortschritte mit Aluminium-Legierungen für den Schiffbau). B. Schulz. *Korrosion und Metallschutz*, Vol. 7, Aug. 1931, pages 218-219.

The utilization of pure Al and KS-Seewasser is pointed out and the anodic treatment of Duralumin and Lautal stressed. The importance of eliminating the inclusions of gases and oxides is discussed and the results gained from some practical applications of Al-alloys on various ships are given. EF (9)

Unfired Pressure Vessels. W. Spraragen (American Bureau of Welding.) *Industrial & Engineering Chemistry*, Vol. 23, Feb. 1931, pages 220-226.

19 references. The article discussed the results of various tests on unfired pressure vessels. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 223. MEH (9)

Elinvar Hairsprings for Watches. G. E. Shubrook. (Hamilton Watch Co.) *Metal Progress*, Vol. 21, Feb. 1932, pages 58-63.

Elinvar an alloy of 53-61% Fe, 33-35% Ni, 4-5% Cr, 1-3% W, 0.5-2% Mn, 0.5-2% Si, 0.5-2% C has 3 properties which adapt it to the manufacture of watch parts, constant modulus of elasticity, resistance to magnetization, and resistance to corrosion. WLC (9)

Aluminum Cast Alloys in Aeroplane Motor Construction. (Aluminiumgusslegierungen im Flugmotorenbau.) C. Panseri. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 13, 1931, page 882.

The composition, refining, properties of light-metals and their application for the different parts of motors for aeroplanes is reviewed. Ha (9)

Commercial Vehicle Bodywork in Aluminium. *Metal Industry*, London, Vol. 39, Aug. 21, 1931, pages 180-182.

Memorandum of the British Aluminium Company, Ltd. Examples are given of the use of light metals in automotive transportation, whereby payloads can be increased and dead weight decreased. PRK (9)

Printing with Steel Sheets—Other Metals have a Rival. *Steel*, Vol. 88, Apr. 2, 1931, pages 50-53.

The new process is based on the fact that Hg rejects ink; it does not amalgamate with Fe or steel but readily with Cu and other metals. If, therefore, the areas that are not to print are covered with Cu or Ag and amalgamated these areas will not take ink while the bare steel will take it. The new process was developed in England and is said to give equal results to the collotype with the additional advantage that the surface is permanent while the collotype does not yield more than about 5000 prints. Ha (9)

Large Uses of Steel in Small Ways. 182nd article. Radio Sets. *Steel*, Vol. 88, Jan. 8, 1931, page 44.

Discusses the wide use of steel in the manufacture of parts for radio sets. JN (9)

Large Uses of Steel in Small Ways. 183rd article. Window Shade Rollers. *Steel*, Vol. 88, Jan. 22, 1931, page 42.

The roller shade industry uses 7000 tons of steel annually in the manufacture of springs and end pieces for wooden rollers and in the manufacture of all-steel metal rollers. JN (9)

Gas Cylinders. *Metallurgist*, Apr. 1931, pages 54-56.

An excellent critical comparison of the recommendations of the British Gas Cylinders Research Committee and the Swiss Federal Institution for Testing Materials regarding the mechanical testing of the material of cylinders to be used for the storage and transport of liquefiable gases. VVK (9)

Modern Blacksmithing. *Metal Progress*, Vol. 20, Dec. 1931, pages 84-88.

The author describes modern methods in making ornamental iron work. WLC (9)

Curbing and Tie Rod Design Affords Outlet for Strip. *Steel*, Vol. 88, Jan. 29, 1931, page 47.

A description of a new type of steel curbing developed for use in the resurfacing of worn out concrete pavements. A substantial saving over that of concrete curbing is claimed. JN (9)

Shipbuilding Activity Will Use 400,000 Tons of Steel. *Steel*, Vol. 88, Jan. 22, 1931, pages 15-16.

The American shipbuilding industry will require 400,000 tons of steel during the next 2 years to complete 87 steel vessels now under contract or assured—at a total cost of 300 million dollars. JN (9)

Corrosion-Resistant Steels Meet Industrial Demands. *Steel*, Vol. 88, Jan. 22, 1931, page 50.

Although the total consumption of Ni declined in 1930, the use of Ni steels and Ni products found many new outlets. The petroleum industry made increased demands for high-Ni and Cr steels, Ni-Fe alloys and pure Ni apparatus. The frozen food industry provided an entirely new outlet for Monel metal consumption. The use of Ni steels increased greatly in the manufacture of various types of heavy machinery. There was a great increase in the production of heat-resistant alloys for electrical heating elements. The successful development of an attractive and durable Cr plate on Ni promises to increase the use of Ni in plating. JN (9)

High Elastic Nickel Steel Developed for Ships. *Steel*, Vol. 89, Dec. 28, 1931, pages 28-32.

The characteristics of 6 steels are tabulated and their properties discussed. High elastic steel is used to great advantage for the strength members of the ship's skeleton; a marked saving in weight can be obtained. Ha (9)

Metals in Powdered Form are Pressed and Sintered into Various Shapes. *Steel*, Vol. 89, Nov. 16, 1931, page 40.

Powdered metals are used for automobile bearings, valve tappets, resistance bars, welding rods, tool bits, and the like. The pressures for forming powdered metals range from 6 to 125 tons/in.^{2} according to the desired density. The metals so far supplied in powdered form of from 200 to 500 mesh are Sn, Cu, Zn, Ni, Fe, steel and alloy steels; Ag, Cr, Co, Au, Pt, W, Monel metal, and Pd. Ha (9)

Large Uses of Steel in Small Ways. 184th Article. Typesetting Machines. *Steel*, Vol. 88, Feb. 5, 1931, page 52.

A brief account of the history and operation of the linotype with a partial list of parts made of steel. JN (9)

Large Uses of Steel in Small Ways. 185th Article, Folding Chairs. *Steel*, Vol. 88, Feb. 19, 1931, page 42.

About 300 tons of steel are consumed annually in the manufacture of folding steel chairs. These find a widening market in schools, hotels, offices, hospitals, clubs, apartment houses and even private homes. The features of folding steel chair construction are described briefly. JN (9)

Steel Floor is Built Up of Rolled Structural Shapes. *Steel*, Vol. 89, Nov. 8, 1931, pages 34-36.

The method of construction is described; advantages are said to be elimination of buckling, warping, and bending, and uniform distribution of wind stresses to all building columns. A load of 120 lbs./ft.^{2} can be borne on a 7-foot span. Ha (9)

Develops Cast Iron Roofing for Industrial Buildings. *Steel*, Vol. 89, July 30, 1931, pages 38-39.

The method of laying cast-iron plates on sloping roofs is described and illustrated; this kind of roof resists atmospheric corrosion well. Ha (9)

Forges Exhaust Valve of Alloy Steel with Copper Cores for Cooling. *Steel*, Vol. 89, Sept. 10, 1931, page 42.

Describes a valve for explosion motors. Ha (9)

Gasoline Stations made of Steel. (Tankdienst-Stationen aus Stahl.) *Petroleum*, Vol. 27, Sept. 16, 1931, pages 1-4; Dec. 23, 1931, pages 958-960.

The utilization of steel for the construction of gasoline service stations is shown and 14 advantages for this special usage of steel are pointed out. EF (9)

Tool Steel Analyses and Applications. W. H. WILLS. *Steel,* Vol. 88, June 25, 1931, pages 31-32, 38; Vol. 89, July 9, 1931, pages 33-38.

A classification is given of tool steels and their properties and the fields of specific application are described. Ha (9)

Use of Aluminum Growing in Oil Industry. E. B. SVENSON (Aluminum Co. of America). *National Petroleum News,* Vol. 22, Nov. 12, 1930, pages 137-143.

Uses and applications of aluminum paint and foil. VVK (9)

Molding in Metals. J. HOMER WINKLER. *Brass World,* Vol. 28, Jan. 1932, page 7.

Four methods of producing electrotypes are: Pb molding, electrodeposition, fusible alloy and the galvanotex process. Each process is outlined. WHB (9)

Stresses in Railroad Track. S. TIMOSHENKO & B. F. LANGER (University of Michigan and Westinghouse Research Laboratories). *Advance copy, American Society of Mechanical Engineers,* Nov. 30, 1931 Meeting, 17 pages.

The general problem is discussed and methods of measurement of the stresses described. It is concluded that in a 130-lb. rail, the fillet under the head due to an eccentrically applied vertical load plus a high lateral flange pressure may have a stress range of 70,000 lbs./in.^{2}, from 60,000 in compression to 10,000 in tension, while the head itself, under vertical and lateral load may have a stress range of 75,000 lbs./in.^{2}, from 60,000 in compression to 15,000 in tension. Such repeated stresses are rather close to the endurance limit of ordinary rail steel; slight defects in the material could readily cause failure. It is unlikely that rail stresses start cracks in sound material, but they may do so in the presence of internal shatter cracks. Freeman's suggestions as to causes and possible methods of prevention of shatter cracks are cited. The studies indicate that the maximum bending stress, with similar rail sections, remains constant if the weight of the rail is increased in direct proportion to the load, thus justifying the use of heavier rails as rolling stock becomes heavier. A more uniform stress distribution would result if the web were thickened at the upper part at the expense of the lower part. By such redesign of a 130-lb. rail, the stress at the upper web fillet, which is one of the most highly stressed locations, can be reduced some 20%. The contact stress in the rail head is very localized and very high; it produces mostly plastic flow in the head. HWG (9)

Light Aluminum for Overhead Traveling Cranes. R. L. TEMPLIN. *Engineering News Record,* Vol. 107, Oct. 8, 1931, pages 574-576.

The considerations which should be leading for the use of aluminum in the place of steel for cranes are discussed and formulas for the calculation are given. At present, 15 cranes of this kind of from 10 to 50 tons capacity are in operation at the works of the Aluminum Co. of America. The weight saved by the use of aluminum varies from 26 to 61%. Details of construction are described. Ha (9)

Material for Highly-Stressed Boilers During the Last Decade. Precautions against Tube Failures. (Die Werkstoffe für Hochleistungsdampfkessel im letzten Jahrzehnt. Vorbeugungsmassregeln gegen Rohrmängel.) M. ULRICH. *Die Wärme,* Vol. 54, July 4, 1931, pages 528-534.

Due to the increase in boiler pressures to 120 atmospheres and above, and owing to the rise of super-heating temperatures to about 500° C., the material is stressed to such a degree as to urgently demand fundamental changes with respect to the construction, improved methods of manufacture, development of novel boiler elements and manufacture of high quality material. After making some general statements on carbon and alloyed steels, steel castings, cast iron and on complete boiler parts, Ulrich (See also *Metals & Alloys,* Vol. 2, 1931, page 34) focusses attention on the prevention of defective tubes, going back as far as to the steel ingot. The writer separately treats the individual stress and special material in regard to (a) water tubes, (b) super-heater tubes, (c) preheater units, (d) boiler drums, (e) smaller supplementary parts, forged and cast steel parts, (f) screws and nuts, (g) steam pipe lines. EF (9)

Getting the Most Out of Die Castings. L. H. MORIN. *Metal Industry,* London, Vol. 39, Aug. 28, 1931, pages 197-198.

From *Iron Age,* Aug. 6, 1931. Die casting of odd shapes and of integral dowel pins and so forth saves time in assembling and is cheaper than machining. Illustrations of practical applications are given. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 40. PRK (9)

Utilization of Silver for Chemical Apparatus. (Die Verwendung von Silber in der chemischen Apparatur.) D. MACDONALD. *Die Metallbörse,* Vol. 21, Apr. 8, 1931, pages 653-654.

Due to the low silver price, increasing tendencies are noticed which aim at a wider adoption of silver as a construction material in the fields of chemistry. The favorable properties of this "rare" metal and the commercial utilization up to the present time are discussed. EF (9)

White Metal Antifriction Alloys. F. C. THOMPSON. *Tin,* Dec. 1931, pages 4-6.

In a general discussion of bearing metals the lack of exact knowledge of the properties desired in a bearing metal and the relations to the lubricant is commented upon. In general, Sn-base alloys are preferable to Pb-base alloys. The old practice of hammering the bearing metal surface is strongly deprecated, as it softens the metal and, particularly, breaks up the hard and brittle cubes, with the result that the shaft is scored by the teeth-like particles. Further, in remelting white metals prior to recasting, considerable care should be taken, as Sn readily oxidizes and the Sn oxide so produced is admixed with the metal in the form of very hard, sharp fragments. The use of powdered charcoal or a suitable flux will prevent this, and a better bearing will result. Ha (9)

Exchangeable Cylinder Bushings (Auswechselbare Zylinderlaufbüchsen). E. MAHLE. *Deutsche Motorzeitschrift,* Vol. 8, May 1931, pages 166-180.

Covers wear, hardness tests, manufacture, material, dry vs. lubricated cylinder bushings, advantages of exchangeable bushings, scope of utilization. EF(9)

Material for Boiler Construction. (Werkstoffrage im Dampfkesselbau.) F. NEHL. *Die Wärme,* Vol. 54, Apr. 25, 1931, pages 295-299. Sonderheft "Werkstoff und Herstellung im neuzeitlichen Dampfkesselbau."

The paper which was presented before the Zentralverband des Preussischen Dampfkessel Ueberwachungsvereins, 1931, discusses the sources of failure in service and reports on means of overcoming the difficulties. Seamless and welded high-pressure drums are considered and the manufacture of seamless drums according to the manufacturing method of Roeckner is described. The significance of the yield point at elevated temperatures and of the creep resistance with reference to the calculation of the wall-thickness of drums and tubes is dealt with. The commercial boiler materials exhibiting remarkable physical properties at elevated temperatures are given and their resistance towards scaling is emphasized. Most of the information is clearly arranged in 13 illustrations, diagrams and 3 tables. EF (9)

Seamless Chrome-Nickel Steel Tubes find Diversified Uses. H. D. NEWELL. *Steel,* Vol. 88, Mar. 19, 1931, pages 31-33, 52.

A list of applications, especially in boiler construction, is given and the physical properties of Nirosta KA2-tubes are described. Ha (9)

Metal Foil Applications. R. P. STRANAHAN (Reynolds Metals Co.). *Metals & Alloys,* Vol. 2, Oct. 1931, pages 206-208.

The author describes the application of the use of foils for various purposes, mainly in food packages. WLC (9)

Dental Casting Technic: Theory and Practice. GEORGE C. PAFFENBARGER & W. T. SWEENEY. *Journal of Dental Research,* Vol. II, Oct. 1931, pages 681-701.

A report to the Research Commission of the American Dental Association on work done at the National Bureau of Standards. The relations of the properties of materials used in the production of dental castings to dimensions of the castings were studied. The important materials are the inlay wax, the investment, and the gold alloy. Since all gold alloys show a casting shrinkage, compensation was sought by expanding the wax pattern or the investment, or both. The preparations were made in steel cylinders and the shrinkage noted by fitting the castings into the cavities. It was found that the kind of wax, its expansion or contraction before being invested, the kind of investment (silica, plaster, etc.), the ratio of powder to water, the temperature of the mold, and the temperature of the molten gold are important factors. Castings are shown which correlate physical data and actual results. Castings made in cristobalite (75% cristobalite, 25% plaster) investment at temperatures from 400° to 800° C. gave accurate restorations. The composition of the gold alloy is not given. 17 figures and 8 references. OEH (9)

The Relation of Torque to Tension for Thread-Locking Devices. H. L. WHITTEMORE, G. W. NUSBAUM & E. O. SEAQUIST. *Bureau of Standards Journal of Research,* Vol. 7, Nov. 1931, pages 945-1016.

This investigation was made to determine, under static loads, the torsional resistance to unscrewing the nuts, with and without locking devices and the relationships these torques bear to the stresses in the bolt. The torque required to produce a given stress in the bolt was also determined for each device. 24 manufacturers of thread-locking devices accepted the invitation to submit samples of their device for test and agreed to publication of the results. A total of 41 devices were tested, including such devices as standard nuts, jam nuts and slotted nuts with cotter pins. Only about one-quarter of these devices showed any appreciable difference in the static torque-tension relation from that of the American National coarse-thread standard nut. There was no great difference between the torques for regular nuts with jam nuts and the torques for regular nuts without jam nuts. The torques for slotted and castellated regular nuts with cotter pins were greater than those for regular nuts after the nut had been screwed off sufficiently to develop the shearing resistance of the cotter pin. Unless the cotter pin was a snug fit in the slot, however, the screwing-off torque never exceeded the initial value, because the shearing resistance of the cotter pin was low and the stress in the bolt decreased as the nut was unscrewed. All of the spring and lock washers roughened the bearing surface and the face of the nut. After closing flat they were all permanently deformed. As the nut was screwed off, the torques were at first about the same as those for regular nuts. When the washer had rotated sufficiently for the ends of the washer to cut into the surfaces and offer considerable resistance to rotation, the stress in the bolt had, for many of the spring washers, been reduced to a low value. WAT (9)

Magnesium Alloys in the Aircraft-Engine Construction. G. D. WELTY. *S. A. E. Preprint,* 1931, 9 pages; *S. A. E. Journal,* Vol. 30, Mar. 1932, pages 112-115.

The substitution of Mg base alloys for those of Al is discussed, and the physical properties of Mg and Al castings and forgings are compared. Features of design which should receive special attention when changing from an Al casting or forging to the same part in Mg are emphasized. The most promising immediate field for the Mg alloy is said to lie in those applications where strength and lightness are the main considerations and where high temperature properties are of secondary importance. Machining practice for Mg alloys is covered in some detail as well as the question of protection against corrosion. It is stated that the present casting alloys have proved commercially satisfactory, from the corrosion standpoint, for all types of land service and for most salt water service, in the middle and upper latitudes. In tropical salt water, however, a certain amount of trouble has been encountered and some protective measures appear necessary. A few recent developments in fabricating the Mg alloys are included. Ha+WAT (9)

Ship Builders Seek Non-Rusting High Strength Steels. W. J. PRIESTLEY. *Steel,* Vol. 89, Nov. 30, 1931, pages 33-34.

The newer alloy steels permit a decrease in dead weight of ships without sacrifice of high strength. A table of various structural steels with the desirable characteristics is given; none of these steels has less than 90,000 lbs./in.^{2} ultimate strength with a yield point of from 50 to 90,000 lbs. and a carbon content of 0.3 to 0.4%. Ha (9)

Steel Construction of a Storage House. (Ein Lagerhaus in Stahlkonstruktion.) J. Gollnow. *Montanistische Rundschau, Stahlbautechnik,* Vol. 23, Feb. 16, 1931, pages 9-12.

The steel frame of an 8 story building and assembling is given. EF (9)

Special Quality Steels for Shipbuilding. William Bennett. *Iron & Coal Trades Review,* Vol. 123, Dec. 4, 1931, page 863; *Marine Age,* Vol. 5, Nov. 20, 1931, pages 12-13, 28.

Recent developments are reviewed and the new materials compared with some of other large ships built previously. The mechanical properties of structural Si steels, high-tensile Ni steel and high-tensile castings are given and a few recent examples of modern ships briefly described. Ha (9)

The Manufacture and Use of Steel Railway Sleepers. R. Carpmael. *Engineering,* Vol. 152, Dec. 18, 1931, pages 644-647; Dec. 25, 1931, pages 671-673.

Includes discussion. From paper read before the Institution of Mechanical Engineers. See also editorial commenting on this paper on pages 653-654 of the Dec. 18, 1931, issue. LFM (9)

Steel Railway Sleepers. R. Carpmael. *Iron & Coal Trades Review,* Vol. 123, Dec. 18, 1931, pages 944-945.

The general manufacturing requirements, specifications of materials used, inspection and gaging are discussed and continental and British practice compared. Ha (9)

Developments in Marine Engineering Foundrywork. Summers Hunter, Jr. *Foundry Trade Journal,* Vol. 46, Jan. 14, 1932, pages 33-34.

An article, accompanied by 2 tables and 1 photograph. The progress which has been made in motor-driven ships is referred to and improvements in Diesel engine design and practice are discussed. The fact that so many important parts of Diesel engines are manufactured of cast iron is referred to, and the value of high-duty cast irons in this connection is dealt with. OWE (9)

Wire Rope for Oil Well Pumping. Percy R. Clark. *Wire & Wire Products,* Vol. 7, Jan. 1932, pages 12-15, 33-34.

The advantages of wire rope in oil well pumping are pointed out and results of an investigation made in the oil fields of Rumania cited where economies up to 50% could be obtained. Ha (9)

Steel-Frame Residences Find Favor in France. Vincent Delport. *Steel,* Vol. 88, Jan. 15, 1931, pages 35-37, 42.

A résumé of the principle features of construction and assembly of 5 different types of steel houses erected in France during the past 3 years. JN (9)

Flying Would Be Impossible Without Metals. G. E. Everett. *Metal Industry,* N. Y., Vol. 29, Nov. 1931, pages 481-482.

A general description is given of non-ferrous metals vital to airplane construction, beacon lights, and radio communication, and other essential departments of the flying industry. PRK (9)

Chromium-Molybdenum Steels and Their Use in Aviation (Les aciers au chrome-molybdene et leur emploi dans l'aviation). M. Baer. *Revue de Métallurgie,* Vol. 28, Oct. 1931, pages 570-574.

Cr-Mo steels originated in the United States, but at present are widely used in France for aviation purposes. French analyses include, however, besides 0.30% Mo and 0.75-1.30% Cr, from 1.5-4.0% Ni. Tubing made of it averages, after heat treatment, a minimum tensile strength of 70 kigs./mm.^{2} and 12% elongation. Being air hardening, the material furnishes superior material for aeronautical welding constructions. In case of thin walled tubes, the deposited metal is 50 to 100% thicker than the tube walls, so that no special welding rod is required. Several types of tube welded joints particularly suitable for airplane construction are given. JDG (9)

The Metal-Clad Airship. Carl B. Fritsche. *Journal Royal Aeronautical Society,* Vol. 36, Sept. 1931, pages 818-883.

Brief historical notes on the development of the airship serve as introduction to a complete description of the first successful metal-clad airship, the ZMC-2. The author follows this description with a thorough analysis of the problems of design, construction and operation of this type of aircraft. WHB (9)

Data on Boiler Materials (Berechnungswerte der Kesselbaustoffe). Fr. P. Fischer. *Krupp'sche Monatshefte,* Vol. 12, Oct. 1931, pages 267-271.

New results of investigations made it necessary to revise the previous tables on hot yield point and hot tensile strength of boiler materials, as given by Fr. P. Fischer & V. Ehmcke in *Krupp'sche Monatshefte,* Vol. 10, Dec. 1929, pages 209-211 and abstracted in *Metals & Alloys,* Vol. 1, May 1930, page 521. The 3 new tables give data at elevated temperatures on common boiler steels group I-IV and Izett-steels, on the same steels in forged state and on Ni-bearing boiler steels. GN (9)

Problems Involved in the Choice and Use of Materials in Airplane Construction. P. Brenner. *Technical Memorandum* No. 658, *National Advisory Committee for Aeronautics,* 25 pages. Mimeographed.

This is a translation of an article in *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Nov. 14, 1931, pages 637-648. Comparison of wood, light alloys, and steels. Duralumin and elektron have no actual fatigue limit, while the steels do. On the basis of 100 million cycles, steel, heat-treated to 230,000 lbs./in.^{2} tensile (such as Cr Ni W) has the highest endurance limit per unit weight, elektron is next, and far behind come carbon steels and duralumin. Notched endurance specimens of elektron, however, show up better than steel, according to Ludwik's tests. Wood is also useful for parts subject to vibration. Corrosion of duralumin is discussed, with the usual conclusions that for service under marine conditions it is necessary to use duplex sheet coated with pure Al or a copper-free Al, or else anodic treatment followed by painting or greasing. An alloy "hydronalium" containing 7% Mg, ½% Mn, which, hard rolled, has properties approaching those of heat-treated duralumin, has good corrosion resistance and is promising for floats and hulls. Elektron has too low corrosion resistance for use on seaplanes, but has some use in land planes. Rust proof Cr steel seems so far to be the best solution of the seaplane corrosion problem. HWG (9)

The Selective Application of Castings. R. A. Bull. *Steel Founder,* Vol. 2, Jan.-Feb. 1932, pages 24-28.

The factors governing the use of castings, forgings or welded structures are discussed; steel castings have been extensively used in recent times. The importance of proper design in each case and of research work, particularly as to the causes of failures, is pointed out. Ha (9)

Bearing Metals. C. H. Bierbaum. *Conference on Metals & Alloys, Case School of Applied Science,* Cleveland, Ohio, Paper No. 17, Nov. 1932, Mimeographed. 4 pages.

The importance of a duplex structure, with hard particles that stand in slight relief after the bearing has been worn in, is stressed. The hard particles should not be distinctly abrasive to the journal. While the bearing should be heterogeneous, the journal should be homogeneous. Soft journals will not stand up against bearings with very hard particles. Accelerated laboratory bearing tests are described and study of satisfactory and unsatisfactory used bearings advocated. HWG + Ha (9)

How Much Power Should Gears Transmit? Earle Buckingham (Massachusetts Institute of Technology). *Machinery,* Vol. 38, Oct. 1931, pages 81-87.

Allowable load-transmitting capacity of gears may be considered as to: (1) static tooth load; (2) load capacity when intermeshing so that impact stresses must be considered; (3) load capacity as limited by tooth wear. Excessive pressure will cause surface failure and pitting due to compressive fatigue. Includes formula for determination of allowable load and several tables of strength of gears of different pitch, tooth form and metal. Metals included are cast iron, semi-steel and bronze, cast steel, SAE 1030 steel, SAE 1045 steel, SAE 3245 steel and others of various forms of hardened steel. RHP (9)

Pots 'n' Pans. *Metal Progress,* Vol. 18, 1930, pages 38-41.

Description of applications of Monel, pure nickel, and stainless steels in the Harvey Restaurants in the Cleveland Union Terminal. WLC (9)

British Coinage. *Journal Society Chemical Industry,* Vol. 49, Jan. 3, 1930, page 15.

Brief note on composition of new English silver coinage (Ag, 50%; Cu, 40%; Ni, 5%; Zn, 5%). VVK (9)

Oxy-Acetylene Welded Aluminum Products. *Industrial Gases,* Vol. 12, Mar. 1931, pages 24-30.

Fields for Al and its alloys are broadened by more extensive use of the oxy-acetylene process. Describes new applications of ox weld, e.g., motor truck bodies, decorative furniture, pipe fittings, door frames, "dry ice" containers and roofing. Also gives technique and general rules for welding Al and alloys. DTR (9)

Welding Procedure for Saw Repairing. *Industrial Gases,* Vol. 12, 1931, pages 43-45.

Gives 3 processes and their uses for saw welding. (1) Electric butt or flash welding machine; (2) atomic hydrogen welding torch; (3) oxy-acetylene or gas welding torch. In the future large mills will repair broken and cracked saws by welding. DTR (9)

Aluminum Cans. *Journal Society of Chemical Industry,* Vol. 50, Apr. 17, 1931, page 324.

The increased use of aluminum for the preservation of foodstuffs by the canning and allied industries has led to the standardization of sheets suitable for the purpose. These are supplied in boxes of uniform weight of 112 lbs., in which the number of sheets varies with the size and thickness. In the following abbreviated table the thickness and size of the aluminum sheets is given, together with the number of sheets to the hundredweight; there is also an indication of the gage and designation of the corresponding tinplate:,

Thickness in.	Tinplate gage and designation	Size	Approximate No. of sheets per cwt.
0.0124	29.9 IC	20x14	330
0.0156	28 IX	28x20	130
0.0179	26.8 IXX	30x21	99
0.0201	25.8 SDK	22x15	174
0.0225	24.8 XXXX	20x14	182
0.0375	20.4 DXXXXXX	34x25	35

It is pointed out that the number of sheets varies slightly and the thickness is subject to the usual commercial rolling tolerances of ± 2%. If desired, thinner sheets may be obtained, but the makers do not encourage this because of the softness of the metal, except in cases of very small containers that do not call for very much working. (9)

Chromium Plating's Largest Field is Industrial. *Metal Industry,* N. Y., Vol. 29, Oct. 1931, pages 430-432.

A list of the properties and industrial uses to which Cr plate has been put is given by the Vacuum Can Company. PRK (9)

Powdered Metals Open New Field in Alloy Applications. *American Metal Market,* Vol. 38, Aug. 29, 1931, page 5.

Originally printed in the bulletin of International Nickel Co. Points out the modern trend of using powdered metals, either as fine as talcum or as coarse as granulated sugar. Used in making paints, inks, welding wires, various alloys and bearings for automobiles and electrical equipment, which never have to be oiled. They may also be sprayed on metals as well as mixed with or sprayed on plastic materials. Powdered Ni, Cu and Sn make possible production of porous metal bearings capable of holding 4-6% of their own weight of liquids. Charles Hardy of New York has been in the forefront of powdered metal development. DTR (9)

Twist Drills, Proving Their Quality. *Metal Progress,* Vol. 20, Oct. 1931, pages 48-53.

Studies at Morse Twist Drill and Machine Co., New Bedford, Mass., in development of better twist drills and methods for controlling their quality are discussed. WLC (9)

Lead Fittings for Modern Dwellings. *Metal Industry,* N. Y., Vol. 29, Sept. 1931, page 396.

Illustrates the use of Pb around homes. PRK (9)

Steels for Aircraft Engines 1918 vs. 1930. *Metal Progress,* Vol. 19, Jan. 1931, pages 70-76.

Substitution of aluminum alloy parts for cast iron and use of lighter sections of heat-treated steels has greatly reduced the weight:horsepower ratio of internal combustion engines. Discussion of steels and their applications. WLC (9)

Manufacture of Springs from Hardened Low-Carbon Steel. (Ueber die Herstellung von Federn aus gehärtetem weichen Flussstahl.) H. Wiesecke. Doctor's thesis, Technische Hochschule Aachen, 1931. Paper, 6 x 9 inches, 81 pages.

Basic Bessemer and basic open-hearth steel of .04 to .12% C was hot rolled to about 6 mm. diameter, water quenched and drawn down to about 3.6 mm. diameter. In a commercial-scale test, material of 0.06% C, rolled to 6 mm. diameter, and cooled normally on the hot bed, gave 66,000 lbs./in.^{2} tensile, 33% elongation. After quenching by immersing the 120 lb. coils in cold circulating water (providing the quenching temperature was high enough, i. e., if the rods were not too cold and the time in rolling not too long), the tensile strength rose to 87,000-105,000 lbs./in.^{2} averaging 94,000, with about 17% elongation. On drawing down to 3.6 mm. wire, the tensile strength rose to 142,000-172,000 lbs./in.^{2} Such wire was reported by spring makers as satisfactory for coiled springs.

A previous large scale test was unsuccessful because it was run on Monday morning, with the rolls, reels, etc. too cold so that the quenching temperature was below 910° C. The quenching water must not be allowed to warm up.

The conclusion is drawn that very great attention must be paid to the control of the process, else segregation in the ingot, differences in quenching temperature, in water temperature, etc., will prevent getting the desired properties uniformly.

The quenching method is only applicable to relatively small diameter wire, and to small coils, but the cheapness of the starting material as compared to higher carbon steel, within the limits in which it is applicable, makes it promising for use by plants having available cheaply the large amounts of water necessary for quenching, and willing to exercise the close control required. Basic Bessemer steel is preferred, though open-hearth is usable.

Properties are plotted of several low carbon steels subjected to many tests in the laboratory, and the metallography of the structures obtained is discussed in some detail.
H. W. Gillett (9)-B-

Metals and Alloys in Modern Building. G. Magulo. *Conference on Metals and Alloys, Case School of Applied Science,* Cleveland, Ohio, Paper No. 13, 1931, 2 pages. Mimeographed.

Brief comment on applicability of various metals to modern architecture, both for decorative use and as structural parts. Ability to preform parts in the factory and erect them speedily on the job is a factor. HWG + Ha (9)

Trucks with Aluminum Tanks. (Grosstankwagen aus Aluminium). *Petroleum,* Vol. 27, June 24, 1931, pages 4-5.

Illustrations and description of aluminum tanks with a gasoline capacity of 2400 gals. built by the Standard Steel Works, Kansas City, Mo., and with a capacity of 10,000 liters built by the Daimler-Benz A. G., Gaggenau, Baden. EF (9)

Something on the Possibilities for Use of Beryllium Alloys for Tools (Etwas über die Verwendungsmöglichkeiten von Beryllium-Legierungen im Werkzeugbau). *Das Werkzeug, (supplement to Maschinenkonstrukteur-Betriebstechnik),* Vol. 7, June 10, 1931, page 124.

Be is of use particularly for pressing and stamping tools because of its light weight, corrosion-resistance, and high elasticity. Its chief range of usefulness lies in the alloying with 20% Cu, Ni or Fe. Beryllium bronzes have a relatively high tensile strength and high elongation. They are the alloys of Be whose production is of practical value. MAB (9)

Light Metal Alloy Pistons for Combustion Engines. (Kolben für Verbrennungskraftmaschinen aus Leichtmetallegierungen.) W. Schulze. *Dinglers Polytechnisches Journal,* Vol. 346, Dec. 1931, pages 193-195.

Statistic data are presented showing the substitution of light metal alloy pistons for cast-iron pistons since 1926, and the technological reasons therefor are summarized. The writer then takes up the various construction devices which must be borne in mind when designing light metal pistons. The different materials available and their physical properties with reference to their chemical composition are considered and the paper concludes with a discussion of the various kinds of testing to which the materials employed are submitted. EF (9)

Special Copper-Bearing Alloys as Recent Commercial Materials (Sonderlegierungen aus Kupfer als moderne technische Werkstoffe). W. Schulze. *Dinglers Polytechnisches Journal,* Vol. 346, Oct. 1931, pages 164-167.

Attention is focussed upon Monel metal, artificial Monel metal and other Ni-Cu alloys, Ni-bearing brasses and bronzes, German silver, brass and bronze containing additions of Al, Cu-Al alloys. Chemical analysis, physical and chemical properties, commercial utilization, etc., are dealt with. EF (9)

Alloys in Aircraft Engines. R. R. Moore. *Conference on Metals and Alloys, Case School of Applied Science,* Cleveland, Ohio, Paper No. 18, Nov. 1931, 6 pages. Mimeographed.

Résumé of previous papers by the same author. See "Materials of Construction in Aircraft Engines," *Metals & Alloys,* Vol. 1, Nov. 1930, page 849. HWG+Ha (9)

Growing Use of Chromium Plating in the Rubber Industry. N. Hal McKay. *Rubber Age,* Vol. 29, Sept. 25, 1931, pages 554-556.

Great economies due to high resistance to wear and corrosion were effected by the use of chromium plating of mill rolls, tuber screws, molds, mandrels and other equipment necessary to the manufacture of rubber. Ha (9)

The Development of the Werdau Light Metal Coach Construction (Die Entwicklung des Werdauer Leichtmetall-Omnibus-Aufbaues). Lindemann. *Verkehrstechnik,* No. 4, 1931, pages 180-181.

Description of the 3 axle chassis for 48 seats. The saving in weight over the same construction in steel is 27%, although the same properties are present as would have been the case with steel. Ha (9)

Economy of Steel Ties is Proved at Scarbro Mine. A. R. Long. *Coal Age,* Vol. 36, Sept. 1931, pages 483-484.

A tabulation covering 3 years shows a total saving of almost $18,000 over wood ties. Ha (9)

Silumin in Mining and Crude Oil Production. (Silumin im Bergbau und in der Rohölgewinnung.) E. Lohrke. *Petroleum,* Vol. 27, Dec. 1931, pages 955-958; *Montanistische Rundschau,* Vol. 23, Oct. 16, 1931, pages 276-278.

A table collecting 15 different physical properties of 5 commercial light metals and light metal alloys is given and the actual utilization of Silumin in mining industries is demonstrated by several examples. EF (9)

Pacific Coast Harbors Open Market for Steel Piling. Kaye Baron Lansdowne. *Steel,* Vol. 88, Feb. 5, 1931, pages 48-50.

The growing popularity of the Dietz method of open sea harbor construction on the West Coast as a trade asset to cities lacking in natural harbor facilities and the northern spread of the marine borer which attacks wooden piling, are both contributing to the development of a large present and future market for American steel piling in competition with German steels. JN (9)

Metallurgical Chemistry in the Aeronautical Industry (La chimica metallurgica nell' industria aeronautica). Adelaide Labo. *Rivista Aeronautica,* Vol. 7, July 1931, pages 30-44.

Light metals used for the construction of different parts of the airplane are reviewed and their physical and chemical properties are outlined in functions of their heat treatment. The chemical compositions of the special steels used by the American aviation industry are listed in tables and reference is made to types of steel employed in fuselage construction. Aluminum alloys are considered with emphasis on their increasing importance and the composition of duralumin, superduralumin, cast aluminum, alpax, lautal, avional and antierodal is discussed. The article concludes with references to the advantages of different forms of Mg alloys and their mechanical properties, as well as the possibilities of Be alloys. WAT (9)

Light Metal Alloys for Materials of Construction in the Machine Industry (Leichtmetallegierungen als Baustoffe in der Maschinenindustrie). M. Koenig. *Congres International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 561-573. 3 figures, 18 references.

Composition and properties of 10 Al alloys, electron, medium carbon steel and Ni Cr steel are compared. Welding and protection against corrosion are discussed. No new data are included in the résumé. HWG (9)

Higher Priced Materials without Added Costs. LeRoy H. Labaw. *Product Engineering,* Vol. 2, Oct. 1931, pages 446-448.

By making full use of the die-casting properties and by designing to save machining and assembly costs, complicated parts were made for cylinder heads, pump yokes, etc. Ha (9)

Stainless Steels. M. J. R. Morris. *Conference on Metals and Alloys, Case School of Applied Science,* Cleveland, Ohio, Paper No. 2, Nov. 1931, 5 pages. Mimeographed.

Flat sheet metals are coming into architectural use. The Empire State Building was erected in 60 days' less time because of the use of sheet. The main fields for stainless alloys are in exterior architectural use, in resistance to dry corrosion (scaling at high temperature) and in resistance to wet corrosion. Very brief comment is given on types of alloys, treatment and uses. HWG + Ha (9)

Practical Advice Concerning the Building of Monel Metal Dye Tanks (Praktische Ratschläge zur Konstruktion von Färbetanks aus Monell-Metall-Blech). R. Mueller. *Melliand Textilberichte,* Vol. 12, Jan. 1931, pages 73-76.

Anticipating the special requirements to be met with in tanks of the dyeing industry, the author takes up fully the following problems: (1) strength of the solders and their corrosion resistance; (2) folded joints; (3) welded joints, (a) oxy-acetylene welding, (b) electric arc welding; (4) flanging and riveting. EF (9)

Reinforcing Main-Line Railway Bridge by Welding. A. M. Knowles. *Engineering News Record,* Vol. 107, Sept. 10, 1931, pages 411-412.

The method of increasing the section of each flange by 36 in.^{2} and 22 in.^{2}, respectively, in order to keep within safe limits of stress is described in detail; 63,000 lbs. of metal was added; 2460 lbs. of welding wire was employed. Ha (9)

High-Pressure Pipe Lines. J. Kloepper & J. Wasser. *Engineering Progress,* Vol. 12, June 1931, pages 121-127.

The making and laying of gas lines for 115 lbs./in.^{2} and water lines of 2¼ to 3 ins. wall thickness is treated in detail. The pipes are water-gas or fusion-welded with lap welds. Several examples are illustrated. Ha (9)

Alloys in Machine Tools. D. M. Gurney. *Conference on Metals & Alloys, Case School of Applied Science,* Cleveland, Ohio, Nov. 1931, Paper No. 15, 7 pages. Mimeographed. *Metal Progress,* Vol. 21, Jan. 1932, pages 46-51.

The machine tools used in working metals, including lathes, planers, shapers, milling machines, drills and grinders are discussed. The development from ordinary steel to high-speed steel and the advent of electric drive and its influence on the construction are described at length. 3½% Ni steel, low Cr-Ni steels and medium Cr-Ni steels are used in great quantities, in the production of gears, high-duty shafts and carburized parts. As an example of the various materials, the design of a turret lathe is described with its ferrous and non-ferrous alloys for the different places. The composition of several standard alloys is given.
WLC + HWG + Ha (9)

Use of Aluminum and Magnesium Alloys in Modern Construction, Part 2 (L' impiego delle leghe di alluminio e di magnesio nelle costruzione moderne, Part II.) G. Guzzoni. *La Metallurgia Italiana,* Vol. 23, Dec. 1931, pages 1146-1161.

Rather general discussion of casting, forming by rolling, extrusion, forging, etc., and of machining the light alloys. Riveting and welding are also briefly considered. Chiefly a résumé of facts elsewhere available. Contains 10 references, 15 figures. HWG (9)

Office Building of Steel and Glass. William F. Holland. *Steel,* Vol. 88, Jan. 22, 1931, pages 35-37.

Describes the new all-steel and glass office building of the Worcester Pressed Steel Co. at Worcester, Mass. JN (9)

HEAT TREATMENT (10)

Case Hardening & Nitrogen Hardening (10c)

Carburizing With Gas in an Electric Furnace. H. E. Koch. *S.A.E. Journal*, Vol. 29, Nov. 1931, pages 369-371.

Nitriding sometimes demands a furnace which cannot be kept employed all the time. It also stimulates the development of carburizing processes. A furnace is described which can be used for both nitriding with ammonia and carburizing with either city gas or gas produced by vaporizing a specially blended compound. Carburizing costs by this method and by the electric box-furnace method are tabulated for comparison. Relatively low first cost and operating cost and a high degree of flexibility are claimed for the equipment. Discussion has to do with difficulties with alloys in high temperature equipment, the effect of the diffusion treatment, methods of packing work to secure uniform treatment, and protection of local surfaces which should not be case-hardened. WAT (10c)

Gears for Aircraft Engines a Quality Product. A. K. Hamer. *Steel*, Vol. 89, Aug. 6, 1931, pages 41-42, 95.

The reasons for spalling of gear teeth of carburized steel are discussed and a Cr-V steel and its proper treatment described for a high quality product. Micrographs to show the fine structure are reproduced. Ha (10c)

An Appraisal of Nitriding. M. A. Grossmann. *Engineering*, Vol. 131, June 19, 1931, page 802.

Paper read before the American Iron & Steel Institute, New York, May 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 246. LFM (10c)

What is Nitriding? How is it Done? J. H. Cates. *Machinery*, Vol. 37, Mar. 1931, pages 489-493.

A general discussion and explanation of the principle and methods and apparatus involved in carrying out this process. Ha (10c)

Nitriding of Alloyed Steels. W. J. Merten. *Heat Treating & Forging*, Vol. 17, Jan. 1931, pages 27-30.

The process of nitriding depends on 3 reactions: (1) decomposition of ammonia (NH_3) into nascent N and free H gas; (2) interaction of nascent N with metallic elements to form complex nitride $Mo_3N_2Fe_2N$ and $Cr_2Fe_2N+Fe_2N$ (depending on composition of alloy steel); (3) diffusion of the nitride through the matrix, forming solid solution with Fe at the temperature of the processing cycle. Maximum solubility is reached at 1100° F. The decomposition of NH_3 takes place at a temperature of approximately 800° F. An equipment of nitriding furnaces is described. Ha (10c)

How to Obtain Best Results in Nitriding. J. H. Cates, Jr. *Machinery*, Vol. 37, June 1931, pages 742-743.

The preparation of the work to be nitrided, the composition of the steels suitable for nitriding, protecting surfaces that are to be left soft are generally discussed. Ha (10c)

Recent Experiences with Nitriding Steel, Especially in Construction of Machine Tools. (Neuere Erfahrungen mit Nitrierstahl, insbesondere im Werkzeugmaschinenbau.) W. Haufe & F. Bruehl. *Krupp'sche Monatshefte*, Vol. 12, Nov. 1931, pages 295-299.

A few tests are described for determining if any changes in accuracy of assembly, deformation, hardness could be detected with nitriding steel after different times of operation. Nitrided gears for instance showed after 10,000 hours of service no trace of wear. 8 references. Ha (10c)

Nitriding Containers. J. W. Harsch & J. Muller (Leeds & Northrup Co.). *Metal Progress*, Vol. 20, Dec. 1931, pages 41-44.

A parasitic reaction by which containers for nitriding rob the atmosphere of NH_3 available for nitriding the charge has been observed with certain container materials, notably 18-8. As the containers are used, poorer nitriding results are obtained in the charge and heavy nitriding of the container takes place. High nickel alloys (Ni over 60%) and inert nonmetallic materials (fused silica, etc.) were found very resistant to nitriding. Mn content in the nickel alloys above 0.50% results in rapid attack of the container material. Enamel coatings are commented upon but their expansion characteristics and mechanical properties offer difficulties. Of the alloys, one of 62% Ni and 12.5% Cr is best suited; 18-8 is poorest. All metals are more or less affected and welding affects their resistance. A semi-refractory insulating brick container backed by welded metal container to be gas tight offers the best solution of the problem. WLC (10c)

Hardness and Crystal Structure of Nitrided Steels Linked. O. E. Harder & Geo. B. Todd. *Steel*, Vol. 88, Mar. 19, 1931, pages 51-52.

Investigations of the correlation of hardness and crystal structure of nitrided steels at different depths suggest the desirability of developing nitrided cases consisting entirely of the α-Fe phase; it was found that cases showing the face-centered cubic and α-Fe lattice were not brittle; methods should therefore be developed which produce nitrided cases free from the hexagonal lattice phase. Ha (10c)

Correlation of the Crystal Structures and Hardness of Nitrided Cases. O. E. Harder & G. B. Todd. *Transactions American Society for Steel Treating*, Vol. 19, Nov. 1931, pages 41-65.

See abstract of preprint, *Metals & Alloys*, Vol. 2, Dec. 1931, page 309. WLC (10c)

Deep Nitriding by Program Control. J. W. Harsch & J. Muller (Leeds & Northrup Co.). *Metal Progress*, Vol. 21, Jan. 1932, pages 74-76, 94.

Variables in nitriding, materials in the reaction zone, temperature, time during which the reaction proceeds and the rate and manner of flow of the active agent are discussed. Operations of commercial nitriding are proper heat treatment, cleaning and charging of the work, sealing and flushing the chamber free of air with NH_3, heating the chamber, holding the work and chamber at temperature for proper time, and cooling the work and chamber. A duplex cycle of temperatures is described to attain high surface hardness and gradual drop from surface to core hardness. Any program of temperature cycle to give desired results as to penetration and hardness may be designed and controlled with proper instruments. Critical factors in nitriding cycles are discussed. WLC (10c)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

The Electrical Weldability of Silicon Bearing Structural Steels. (Die elektrische Schweissbarkeit des Siliziumbaustahles.) Hochheim. *Die Wärme*, Vol. 54, June 26, 1931, pages 493-494.

Tests on two structural steels with 1% Si (0.12% C) and 0.8% Si (0.20% C) disclosed that no harmful effect is exerted by Si on the welding properties. EF (11c)

Determines Heat Distribution in Torch-Cut Structural Steel. R. L. Geruso & T. N. Hannant. *Steel*, Vol. 89, July 16, 1931, pages 39-40.

As steel becomes brittle when heated to 572° F. it was the question how structural steel was influenced when cut or welded by the oxy-acetylene torch. From a series of tests it could be concluded that temperatures do not exceed 510° F. and that only mild heat stresses below those required for safety are generated when the preheating flame is run over the line of cut. Ha (11c)

The Strengthening of Welded Joints by Cross Straps. E. Hoehn. *Engineering*, Vol. 131, Apr. 17, 1931, pages 525-526.

Author made series of tests on reinforced welded joints. Cover straps were applied across the joint and welded into place. Tests showed that these are best arranged on opposite sides of the plates with the outer strap directly over the inner. Straps properly applied reduce the stress on a welded joint by 30% or more. Diagrams are given showing the method of testing. LFM (11c)

Reinforced Concrete Construction and Welding Technique. (Eisenbetonbau und Schweisstechnik.) R. Hoffmann. *Beton und Eisen*, Vol. 30, Aug. 1931, pages 284-285.

The replacement of the universally used tied joint by welded joints, their greater economy, superior rigidity and other favorable structural properties in reinforced concrete construction are reported. Attention is directed to the utilization of the spot welded fabric for structural work and some future possibilities of welding along this line are touched upon. EF (11c)

Some Methods and Effects of Machine Gas Cutting. L. M. Curtiss. *Western Machinery World*, Vol. 22, Dec. 1931, pages 547-550; *Iron & Steel of Canada*, Vol. 15, Feb. 1932, pages 13-14, 24; *Industry & Welding*, Vol. 3, Jan. 1932, pages 1-5, 24; *American Machinist*, Vol. 75, Nov. 19, 1931, pages 784-785.

The methods of machine gas cutting heavy plates and the metallurgical effect upon the metal cut as well as the economics of the problem are discussed. There has been considerable discussion, especially among the users of steel plate, as to the effect of gas cutting upon the material cut. When observed microscopically, the cut edge is found to be materially altered as compared with the original metal. Apparently this is a physical change, as the pearlitic steel has been transformed into an unstable condition, taking one of 3 forms: sorbitic, troostitic or martensitic, according to the amount of carbon present and the speed with which the metal has been cooled. Considerable grain growth also occurs at the cut edge. The carbon content of the cut edge is also higher than the original metal. This is attributed to the fact that the pearlite patches in the original steel were absorbed while passing through the transformation range, forming austenite; the ferrite was thrown out of solution on cooling. Annealing or normalizing a gas cut piece will restore the original properties of the material. OWE + RHP + Ha + WAT (11c)

Technique in Stamping and Resistance Welding (Stanzereitechnik und Widerstandschweissung.) Felix Goldman. *Maschinenbau*, Vol. 10, Aug. 6, 1931, pages 489-492.

Discusses the influence of resistance welding on strength, the science of resistance welding, weldable materials and strength, welding practice, construction of the apparatus, methods, loads and costs, welding procedure, preparation of the welding rod, effect of welding on the material, and testing of welds. MAB (11c)

Health in Welding Shops. W. von Gonzenbach. *Welding Journal*, Vol. 28, Nov. 1931, pages 344-345.

Paper read before the Tenth International Congress of Acetylene and Welding Industries, Zurich, July 1930. The author, an industrial hygienist, discusses the chemical and physical dangers to health of oxy-acetylene and arc welding. Good ventilation and proper protection from sparks, dazzling light and infra-red rays are essential. Instruction and education of workmen is suggested. TEJ (11c)

V or X-shaped Seams? (V oder X Nähte?) E. Höhn. *Die Wärme*, Vol. 54, Nov. 28, 1931, pages 885-887.

Although, on account of the smaller cross sectional area, the X-shaped seam requires both less material and work, the V-shaped seam has apparently been preferred by the shops for the same sheet size. The adequacy of both seam profiles are critically discussed from the view-point of internal stresses. The valuation resulting seems to speak in favor of the X-shaped seam. The soundness of the V-shaped seams is endangered to a larger extent due to the occurrence of blow-holes, notches and other discontinuities. EF (11c)

Gas Cutting Alters Steel Structure. L. M. Curtiss. *Machine Design*, Vol. 3, Dec. 1931, page 31.

As gas-cutting changes the pearlitic structure it is necessary to anneal the steel after cutting, or preheat the steel which will prevent the change to some extent. Ha (11c)

Machine Gas-Cutting Heavy Plate. L. M. Curtiss. *Steel*, Vol. 89, Nov. 16, 1931, pages 31-33, 38.

Some results of comparison between acetylene and gas-cutting of heavy plate are given. There is usually an increase in carbon on the outside gas-cut edge, and a hardening effect takes place. This effect can be eliminated if the steel is preheated before gas-cutting. The depth of penetration of the altered zone has been found to have a definite relation to the thickness of the material cut; this relationship is shown on a chart. Ha (11c)

Frame for Astronomical Telescope. A. F. Davis. *Journal American Welding Society*, Vol. 10, Nov. 1931, page 8.

In order to save weight and give a structure with a minimum of deflection, arc welded steel construction was used for a large telescope tube. TEJ (11c)

Oxygen Machine Cutting. *Industrial Gases*, Vol. 12, Mar. 1931, page 23.

Deals with fuel gas used with O, acetylene, coal gas, and H, citing advantages of each. DTR (11c)

Welding Alloy Steels Improves Ordnance. *Metal Progress*, Vol. 18, Nov. 1930, pages 68-74.

Developments in welding practice using the X-ray as a guide are described. The Watertown Arsenal has made marked improvements in welding technique and quality of ordnance structures by the X-ray development of welding methods. WLC (11c)

New Washer Punch Press of All-Welded Rolled Steel Construction. Everett Chapman (Lukenweld Inc.). *Journal American Welding Society*, Vol. 10, Nov. 1931, pages 43-44.

Description of a large punch press; the housing, outboard bearing assembly, gears, pinions, flywheel and other parts of which were fabricated by gas-cutting, forming and arc welding of rolled steel plates and slabs. A reduction of over 2⅛ tons in the total weight of the press was accomplished through efficient design and more economical distribution of metal. TEJ (11c)

The Oxy-Acetylene-Welding in the Building of Pipe Lines. (Die Azetylen-Sauerstoffschweissung im Rohrleitungsbau.) H. Buchholz. *Autogene Metallbearbeitung*, Vol. 24, Dec. 1, 1931, pages 351-355.

This method is particularly suitable for welding pipe lines as oxide-constituents and gas inclusions are kept away from the melt and the weld possesses a high strength and great elongation. Besides, oxy-acetylene welding guarantees a dense weld. Illustrations and tests are given of joints and flanges. Ha (11c)

New Type of Hydrogen-Air Blowpipe for Lead-Burning. *Industrial Gases*, Vol. 12, Mar. 1931, pages 37-38.

New type of portable blowpipe for repairs in out-of-the-way places. It is not to replace blowpipes using O with fuel gas. Gives details of tests and shows specimens of work on lead and pewter. DTR (11c)

The Welding of Alloys. *Industrial Gases*, Vol. 12, June 1931, pages 93-97.

Reprinted from *Oxy-Acetylene Tips*, Vol. 6, Feb. 1931, together with excellent pointers. Practically all types of alloys, ferrous and non-ferrous, can readily be welded by the oxy-acetylene process. Most alloys have qualities peculiar to themselves, which of course require slight alterations from the standard welding practice. The various details of these slight alterations are given for Cr and Cr-Ni steels, Mn steels, Mo, V and Si-Mn-Cr steels, Si irons, Al and its alloys, Ni and monel metal, Cu and its alloys. DTR (11c)

Welding Aluminum. *American Metal Market*, Vol. 38, June 13, 1931, page 4.

Reprinted from instruction bulletin of Aluminum Company of America. Expert and detail instructions for gas torch, metallic arc and carbon arc welding are given. Also for the welding of castings. The types of fluxes, size and kind of flame, thickness of metal, preparation of material, kind of welding rods, etc., are thoroughly explained. DTR (11c)

Fast Welding Cuts Line Costs. *American Gas Journal*, Vol. 135, Oct. 1931, pages 59-60.

Description and discussion of the new Lindeweld process of oxy-acetylene welding. Labor and materials costs are said to be reduced while construction is speeded up. CBJ (11c)

Fusion-Welded Drums Authorized by A.S.M.E. Boiler Code Committee. *Power*, Vol. 74, July 21, 1931, page 107.

After 10 years of study and discussion, power boiler drums fabricated by fusion welding have been authorized by the Boiler Code Committee of the American Society of Mechanical Engineers. Welding requirements are specifically outlined for 3 classes of vessels. Class 1 vessels may be used for any purpose without restriction. Class 2 vessels may be used for any purpose except for holding lethal gases or liquids, or holding any liquids at a temperature of 300° F. or above. The maximum pressure at which any vessel can be operated is 400 lbs. and the maximum temperature 700° F. The maximum plate thickness is 1½ in. Class 3 includes all vessels covered by this code not exceeding ⅝ in. plate thickness and used for the storage of gases or liquids at temperatures not materially exceeding their boiling temperature at atmospheric pressure, and at pressures not to exceed 200 lbs. or temperatures not to exceed 250° F., and providing also that the gases or liquids are not lethal. Class 1 vessels and boiler drums must have X-ray examination and stress relieving by over-all heating. The requirements for fusion-welded boiler drums are: a joint efficiency of 90%; tension bend and specific gravity test pieces taken from a continuation of the weld; the bend test specimen, transverse to the welded joint, to show a fiber elongation of 30% without cracking; a minimum specific gravity of the weld metal of 7.80; X-ray tests for plate thicknesses of 3 in. and less; heating the shell, in toto or by sections, to at least 1100° F. for 1 hr. per in. of thickness. VVK (11c)

Riveting (11d)

Rivets in Metal Airplane Structures. (Das Nieten im Metall-Flugzeugbau.) Erich Rickert. *Maschinenbau*, Vol. 10, Aug. 6, 1931, pages 502-504.

Reviews the work of Pleines (See *Metals & Alloys*, Vol. 2, May 1931, page 104) concluded in 1928 on the riveting material used in Germany for airplanes. Discusses the present status of riveting for such structures. The same methods of manufacture for this kind of rivet can be used for other industrial construction purposes. MAB (11d)

Eliminating Scale on Rivets. D. J. Champion. *Boiler Maker*, Vol. 31, Jan. 1931, page 23.

By using a different shaped head when driving than one which conforms exactly to the style of head originally found on the rivet, the scale on the head will be broken. Ha (11d)

Melting & Refining (12a)

Deoxidizers and Fluxes. G. L. Bailey. *Foundry Trade Journal,* Vol. 46, Jan. 7, 1932, page 6; Jan. 21, 1932, pages 57-60; *Metal Industry,* London, Vol. 40, Jan. 8, 1932, pages 31-34.

An article dealing with non ferrous metallurgy, in which the author discusses first the subject of deoxidizers, pointing out that these materials must be capable (1) of reducing existing oxides and (2) of being readily removed from the bath subsequent to their reaction with the oxides in the bath. Discusses the relationship between heat formation and affinities for oxygen at high temperatures and points out that the heats of formation are roughly indicative of the value of various elements as deoxidizers. The behaviour of common deoxidizers is dealt with, special attention being directed to P and B. The uselessness of Al as a deoxidizer is referred to. Some reference is also made to the alkali and alkaline earth metals in this connection. Attention is directed to the recent work on the deoxidation of metals by reducing gases. The latter part of the paper deals with fluxes, these being defined as (a) solvents for metallic oxides, (b) inert covers to protect metal from oxidation and gas absorption, (c) materials for the removal of impurities other than oxygen, (d) volatile salts which remove inclusions by mechanical action, and (e) degasifiers. Special attention is directed to the fluxes which have proved of value in the manufacture of Al, Mg and light metal alloys. 2 tables and 8 photographs. PRK+OWE (12a)

Carbon-Oxygen Equilibrium in Liquid Iron. H. C. Vacher & E. H. Hamilton. *Rolling Mill Journal,* Vol. 5, Mar. 1931, page 210.

Abstract of a paper presented at the New York Meeting of the American Institute of Mining and Metallurgical Engineers, week of Feb. 16, 1931. See *Metals & Alloys,* Vol. 2, July 1931, page 134. JN (12a)

Iron and Aluminum in Brass Scrap. Edmund R. Thews. *Metallurgist,* Nov. 1930, pages 165-166; Dec. 1930, pages 188-189.

The most important impurities in brass scrap are Fe and Al. Loose Fe is generally removed from brass scrap by magnets. The disadvantages characteristic of more than minute iron contents in common brasses are primarily due to the affinity of iron for carbon and to the low degree of solubility of the iron-carbon compounds in brass. This leads to the formation of extremely hard inclusions concentrated especially along the surfaces of the castings, rendering cutting and finishing treatments exceedingly difficult, if not impossible. Iron carbides are prevented from formation either by increasing the degree of solubility of iron in the brass or by decomposing the carbon compound before casting. The solubility of Fe in brasses increases with the Zn contents, but even the highest Zn contents of commercial brasses do not suffice to dissolve considerable quantities of metallic Fe, such as are accidentally introduced in the form of scrap Fe or to prevent the combination of such Fe with C. Mn tends to increase the separation of Fe from its solution in brass. All brass scrap believed to contain considerable quantities of scrap Fe should be fused at minimum temperatures, preferably in crucible furnaces. Occasional skimming during the melting-down period and the addition of Cu scale to the melt after bringing it up to casting temperatures will remove a large proportion of the Fe. Final decomposition of the iron carbides contained in brass alloys is effected by washing the melt—at full casting temperatures—with a slag consisting of a mixture of equal parts of soda ash and silica sand, the total quantity of slag mixture employed for this purpose amounting to about 3% of the weight of the metal. By this treatment, the carbides are dissolved; the carbon is oxidized; all the iron is absorbed by the brass. The Fe is not removed by this process, but since Fe in solution, while hardening the brass, does not spoil the brass for cutting and finishing, this consideration is of comparatively small importance. If it is desired to effect a reduction of the Fe contents, liberal additions of potassium sulphate should be made during the melting down process; part of this salt is added with the cold charge. The slag formed must, however, be removed before adding the soda ash silica sand mixture, the decomposing influence of which on the iron carbides is considerably reduced by the sulphate. Small percentages of Al may be removed by treatment of the melt with potassium sulphate; the process is carried out as indicated for Fe. However, if this type of scrap is to be employed in the production of high-grade material, it should first be remelted and refined separately, and the ingots produced then added to the virgin brass. Scrap containing considerable quantities of Al should never be used in bulk. The raw material should be remelted and treated with potassium sulphate and the ingots produced added in very small amounts to brass alloy melts of medium quality. The attempt should never be made to use the Al contents of the scrap to make up part or all of the percentage of this constituent in the alloy to be produced. Excessive formation of oxides and dross will remove so much of the original Al as to render accurate calculations useless. VVK (12a)

Flotation of Graphite in Cast Iron. A. L. Norbury & C. Rowley. *Foundry Trade Journal,* Vol. 45, Sept. 24, 1931, page 198.

The authors point out that it is common knowledge that graphite rises to the surface of ladles of molten metal in the case of high total C, hyper-eutectic iron, but it is probably not so generally recognized that graphite can float upward in the partly solidified metal in the case of relatively low total-C cast iron of the cylinder type, which contains as little as 3.3% total C and 1.5% Si; that is to say, which contain much less C than the eutectic composition and consequently have a longer freezing range. Analyses of the total C content of gray pig iron at various points from the top to the bottom of the face of the fractured pig show that graphite does float upward as the pig solidifies. The authors support this contention by quoting various examples of this phenomenon and employ their findings to support the view that graphite is deposited directly from the melt. See also *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 44. OWE (12a)

Casting & Solidification (12b)

Recasting of Bearings in Automobile Repair Work. (Lagerausgiessen bei Automobil-Reparaturen.) K. Haase. *Deutsche Motorzeitschrift,* Vol. 8, Nov. 1931, pages 390-393.

The salient features of a die-casting machine for casting bearings under pressure is described at length. The deficiencies associated with other methods are critically discussed. The author pays attention to furnishing the proof why the new method is more efficient and cheaper on one hand and why the cast bearings are qualitatively superior on the other hand. EF (12b)

The Application of Water-Cooled Molds For Casting Steel. (Die Verwendung wassergekühlter Kokillen zum Giessen von Stahl.) W. Hessenbruch & W. Bottenberg. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, report 188, 1931, pages 205-213; *Stahl und Eisen,* Vol. 51, Dec. 24, 1931, page 1600.

200 kg. ingots of high speed steel, tool steel, stainless chromium steel, and Cr-Ni steel. Melts which had been made in an electric furnace were alternatingly cast in common gray cast iron molds and in a water cooled copper mold. The dimensions of the ingots cast in the 2 types of molds were practically the same. Primary crystallization, appearance of fracture, micro-structure and segregations were studied. During the casting in the water cooled mold the amount of heat taken up by the water was determined. The temperatures of the water increased to about 40° to 50° C. during the casting. The cooling water consumption amounted to about 15 to 20 liters per kg. The ingots were stripped at a temperature of about 900°-1000° C. at the surface. There were no objections as to the appearance of the fracture of the ingots cast in the 2 types of molds. Cracks and pipes were not found in the water cooled ingot when a hot top was used. The primary structure was alike in both cases, and there were no differences as to microstructure and grain size. The segregation of the water cooled ingot in the vertical direction is rather small, but the segregation is somewhat more pronounced in horizontal direction, but as a whole the segregation is not essentially affected by water cooling. In every respect the differences caused by the 2 mold types are rather insignificant. It is shown that the casting temperature much more affects the structure than the type of the mold. The surface of the water cooled cast ingots is much smoother than that of the normal cast ingots. In comparison with the cast iron mold the durability of the copper mold is unlimited. 10 references. GN (12b)

On the Solidification Shrinkage of Carbon Alloys of Manganese, Nickel and Cobalt. Kota Honda, Yosiharu Matuyama & Tadatugu Isobe. *Science Reports of the Tohoku Imperial University,* Sendai, Japan, Vol. 20, Oct. 1931, pages 594-598.

The measurements were made with a thermo-balance; the change of volume during solidification was measured as follows:

Metals	Manganese	98.9% Mn -1.1% C	97.8% Ni -2.2% C	97.8% Co -2.2% C
$\frac{\delta V}{V}$ (%)	-4.5	-1.60	+2.06	+2.03

While Mn and its alloy with C contract, like other metals and alloys, Ni and Co expand; they form an eutectic with C. Since the density of solid C is very small compared with Ni and Co, a great expansion must take place when during solidification C dissolved in these molten metals separates as free C whereas under the same conditions Ni and Co contract; the result of these 2 opposite effects may be positive as actually observed. The case is analogous to that of gray cast iron during solidification. 7 references. Ha (12b)

Centrifugal Casting Process Produces Cylinder Linings Having Superior Wearing Qualities. J. E. Hurst (Sheepbridge Stokes Centrifugal Casting Co., Ltd.). *Automotive Industries,* Vol. 64, June, 1931, pages 882-884.

Shrinkage defects and subcutaneous blowholes due to the defective feeding of the inner central portion in sand castings are eliminated in centrifugal castings. For heavier castings, for use as locomotive piston valve liners and large piston ring drums, the composition of material complies with requirements of "Spun-Sorbitic" patent: the material is of a low Si content and possesses a complete eutectoid structure. After solidification the material is specially cooled. The large grain size is eliminated; this is the chief disadvantage of pearlitic cast iron. Other harder cast iron alloys are used also. One of the latter type contains Mn and Cr and can be used either in its "as-cast" condition or in the oil-hardened and tempered condition. The Brinell hardness of as-cast material ranges from 260 to 320, and of the tempered material from 320 to 475. The tempering is done by heating liners to 850° C. for 10-15 min. and quenching in oil. DTR (12b)

On the Influence of Manufacturing Conditions upon the Properties of Cast Iron Rolls. Kohei Taniguchi. *Seitetsu Kenkyu,* Nov. 1931, pages 224-238.

Under different conditions 3 kg. of roll material, containing 3.11 % C, 0.58 % Si, 0.57 % Mn, 0.592 % P, 0.038 % S, were cast into two molds. A mold was made of sand, in one side a cast iron block being attached. The other mold was made of a porcelain tube heated in a nichrome furnace. By these molds the structures of chilled and sand rolls (or inner part of chilled roll) was obtained, respectively. Hardness of chilled surface and depth of chilling for the chilled castings were measured, and hardness, tensile strength and toughness for the sand castings were also measured. From these results, the influence of the manufacturing conditions upon the properties of cast iron rolls was deduced as follows: High melting temperature and high casting temperature are both favorable to make them as high quality as possible for both chilled and sand rolls, if no trouble is met in practical operation. The most beneficial thickness of iron mold for chilled roll is about 1/3 of the diameter of roll body. The effect of the temperature of mold on the depth of chill was studied. Copper or aluminum mold was tried instead of cast iron mold to increase its chill effect, but the result was not so effective as expected, owing to the formation of a remarkable clearance between mold and roll body immediately after pouring. ST (12b)

The Cooling of Ingots in Molds, Especially of Brass Ingots in Water-Cooled Molds. (Ueber die Abkühlung von Blöcken in Kokillen, insbesondere von Messingblöcken in wassergekühlten Kokillen.) W. Roth. Doctor's thesis, Technische Hochschule, Aachen, 1930. 27 pages.

Small cylindrical ingots of 70 : 30 brass, 15 cm. diameter by 20 cm. high were cast in a thin-walled water-cooled copper mold, in straight and tapered heavy and thin walled cast iron molds, and in dry sand.

Pouring temperature, casting time, and rate of flow of cooling water in the case of the water-cooled mold, were varied. Temperature gradients and cooling rates were determined and compared with mathematical theory. The data are plotted in detail. The time to freeze could be changed 50% by a 15% change in rate of flow of cooling water.

Although the equilibrium diagram indicates that 70 : 30 should have a freezing interval, it was experimentally found to freeze at constant temperature when cooled rapidly. This is claimed to avoid segregation. While material segregation was found in the sand castings the iron mold appeared to avoid it as well as the water cooled mold.

Macro-etching showed the finest grain size on casting from the liquidus temperature into water cooled molds. The next finest grain, with a small transcrystalline outer zone was obtained by casting from 80° C. above the liquidus into a heavy walled iron mold and jarring it during solidification. HWG (12b)

Staveley Sand-Spun Pipes. *Gas Journal*, Vol. 195, July 8, 1931, page 101.

Reviews the pamphlet put out by Stavely Coal and Iron Company Ltd., explaining the firm's process for producing cast-iron pipes by centrifugal casting in dried sand molds, rammed in metal flasks and revolving at high speed until the pipes solidify. MAB (12b)

A New Machine for Centrifugal Casting. (Une nouvelle Machine pour Coulée centrifuge.) Delcroisette. *Revue de Fonderie Moderne*, Vol. 26, Jan. 10, 1932, page 9.

Description of an English casting machine which can be operated by one man. Ha (12b)

Bottom-Cast Practice. Part 17. Edmund C. Bitzer (Mine & Smelter Supply Co.). *Blast Furnace & Steel Plant*, Vol. 19, Dec. 1931, pages 1572-1576, 1587.

Comparison of advantages and disadvantages of bottom casting with those of top pouring. The method of bottom casting is described and the design of stools, runner brick and molds is discussed. Piping and segregation in bottom-cast ingots are considered. MS (12b)

Slush Casting of Aluminium Utensil Spouts. Robert J. Anderson. *Metal Industry*, London, Vol. 40, Jan. 1, 1932, pages 7-10.

Any commercial Al alloy can be used to make a slush cast spout, which is low in cost, has an excellent surface finish, is thin-walled, and of uniform thickness. Factors such as mold design, pouring and finishing are discussed. PRK (12b)

Rolling (12c)

Motors and Control for Rolling Cold Strip Steel. Francis Mohler. *Steel*, Vol. 89, Nov. 30, 1931, pages 31-32, 36; Dec. 14, pages 31-33.

The installation of a four-high-roller-bearing mill is described. The methods of control for maintaining the tension of the strip between mill stands and the necessary equipment is described and illustrated. Ha (12c)

Developments in Sheet Mill Practice. Edward S. Lawrence. *Sheet Metal Industries*, Vol. 5, May 1931, pages 13-16; June 1931, pages 87-91; July 1931, pages 167-168.

Part I outlines recent developments in the equipment for the handling of sheet. Pair heating furnaces, pack heating furnaces, and conveyor systems are discussed. Part II reviews recent patents covering reduction of bars and packs to gage, continuous rolling, normalizing and annealing furnaces, conveyors and pickling machines. The third part discusses patents covering new pickling devices together with those covering annealing boxes. AWM (12c)

French vs. American Sheet Steel. Ed. S. Lawrence. *Heat Treating & Forging*, Vol. 17, Feb. 1931, pages 133-136, 138.

A thorough investigation of French and American practice in the manufacture of sheet steel shows that the sheet bar used by French mills is not as homogeneous in analysis and structure as the sheet bar used here. The present differences in processing can be summarized as less elongation in cold rolling and utilization of continuous normalizers for the second anneal, thus replacing box annealing. Ha (12c)

German versus American Sheet Steel. E. S. Lawrence. *Heat Treating & Forging*, Vol. 16, Sept. 1930, pages 1156-1158.

The author compares the methods employed in America and Germany for the production of steel sheets. Ha (12c)

British versus American Sheet Steel. Edw. S. Lawrence. *Heat Treating & Forging*, Vol. 17, Oct. 1931, pages 955-958.

A comparison of British and American methods of processing full finished sheet steel leads to the conclusion that the irregularity of grain structure in the majority of high grade sheet steels as double box annealed in Great Britain indicates the necessity for basic normalized sheet. American mills could well adopt the lower range of C contents. Ha (12c)

American Rolling Mill Construction (Eindrücke aus dem amerikanischen Walzwerksbau). A. Koegel. *Stahl und Eisen*, Vol. 51, Nov. 26, 1931, pages 1468-1478.

Paper before the Annual Meeting of the Verein deutscher Eisenhüttenleute, Nov. 28, 1931, at Düsseldorf. The average of the American rolling mills is superior to German rolling mills as far as production and saving of manual labor goes. Numerous newer American mills for the production of billets, slabs, beams, rails, all kinds of merchant shapes, rods, plates, sheets, hoops, etc., are described and shown in sketches. Rolling mill furnaces are briefly discussed, as well as bearings, cold rolling and wire drawing. GN (12c)

The Cold Roll Forming of Metal Retainer Strips. D. A. Johnston (Kane & Roach, Inc.). *Metal Stampings*, Vol. 4, May 1931, pages 401-404.

Illustrates and describes layout of 9 sets of rolls used in the cold roll forming of gypsum board retainer strip. JN (12c)

Seamless Steel Tube Manufacturing Methods. G. P. McNiff (National Tube Co.). *Rolling Mill Journal*, Vol. 5, Feb. 1931, pages 127-128, 140.

Abstract of a paper presented before the American Society for Steel Treating, Western Metal Congress, San Francisco, week of Feb. 16, 1931. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 224. JN (12c)

The Design of Rolls for Cold Roll Forming Machines. D. A. Johnston (Kane & Roach, Inc.). *Metal Stampings*, Vol. 4, June 1931, pages 489-492.

A chart developed by the author is furnished for determining the length of arc in any given bend from 5° to 90°; such bend having an inside radius of 1/64 to 5/16 in. and being made from stock 0.005 to 0.200 in. in thickness. JN (12c)

Analysis of Rolling Forces. John H. Hitchcock. *Rolling Mill Journal*, Vol. 5, Sept. 1931, pages 583-586; Oct. pages 659-660.

Theoretical discussion and development of formulas for the calculation. Ha (12c)

Location of the Neutral Line in a Roll Pass. Walter Dahl. *Rolling Mill Journal*, Vol. 5, Aug. 1931, pages 555-557.

A method for determining the neutral line is described and rolling troubles due to the wrong position of the neutral line in a profile pointed out. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 313. Ha (12c)

The Composition of Modern Roll Metals. Part I. John H. Hruska. *Rolling Mill Journal*, Vol. 5, Mar. 1931, pages 163-166.

The chemical analyses of a number of common roll metals—cast iron, cast steel and alloy steels—are given, with a discussion of the properties and uses of the manufactured rolls and the influence of various individual chemical constituents. JN (12c)

Recent Development in Cooling Bed Construction. (Neuere Kühlbettbauarten.) M. Curth. *Stahl und Eisen*, Vol. 50, Jan. 16, 1930, pages 65-70; Jan. 23, 1930, pages 99-105; Translated in *Rolling Mill Journal*, Vol. 4, Aug. 1930, pages 423-426; Sept. 1930, pages 493-494; Dec. 1930, pages 691-694.

Report 73 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. The requirements which cooling beds of high capacity have to meet are outlined. The disadvantages of older types of mechanical cooling beds are discussed and a detailed, illustrated description of modern constructions of cooling beds is given. The article also mentions improvements in mechanical piling of the bars after they have been cut to size. GN + MS (12c)

Antifriction Bearings Aid Progress of Backed-Up Mills. M. D. Baughman (E. W. Bliss Co.). *Steel,* Vol. 88, Feb. 19, 1931, pages 35-37.

The first large cluster mill for cold rolling wide sheets was installed in the Huntington, W. Va., plant of the International Nickel Co. in 1924. This mill was equipped with babbitted bearings. In 1930 the bearings on the necks of the backing rolls were replaced with roller bearings. This effected a considerable saving in power and maintenance costs. The use of antifriction roller bearings on roll necks and on other parts of rolling mills was initiated by the Timken Roller Bearing Co. and furthered by the E. W. Bliss Co. The successful application of roller bearings to mill rolls depends on proper mounting, adequate lubrication, and freedom from overloading. The successful production of flat stock true to gage depends on proper control of the expansion and crowning of the rolls during operation. JN (12c)

Devices and Application for Steel Mill Roll Neck Lubrication. Discussion. *Iron & Steel Engineer,* Vol. 8, Apr. 1931, pages 178-195.

Discussion by representatives of the lubricant makers and 9 users of rolling mill equipment of the problem of roll neck lubrication. WLC (12c)

Sheet and Tinplate Rolls. An Investigation into the Roll Loads, Stresses and the Causes of Roll Breakage. J. Selwyn Caswell. *Sheet Metal Industries,* Vol. 4, Dec. 1930, pages 649-654; Jan. 1931, pages 757-758; Feb. 1931, pages 851-856; Mar. 1931, page 933.

Part I. Discussion of the loads set up by the deformation of the iron and of the torsional loads, giving the formulae used in the calculation of both. Part II. Further work on the calculation of maximum torque is taken up. Part III. Discussion of the stresses set up in a roll while in the foundry. The author divides a cooling roll into 4 zones and discusses cooling rates in each. Part IV. A short discussion on the alteration in the stresses after stripping the molds. See also *Metals & Alloys,* Vol. 2, Dec. 1931, page 313. AWM (12c)

Plastic Shaping in Calculation and Test (Ueber bildsame Formgebung in Rechnung und Versuch). E. Siebel. (Technische Hochschule Stuttgart). *Stahl und Eisen,* Vol. 51, Nov. 26, 1931, pages 1462-1468.

Paper before the Annual Meeting of the Verein deutscher Eisenhüttenleute, Nov. 28, 1931, at Düsseldorf. 19 references. The paper gives a résumé of past and recent investigations on the various processes of plastic shaping, such as forging, rolling, drawing, extruding. These technical processes are discussed and examples given: energy consumption, losses occurring and the course of the deformation. Methods are described to determine the distribution of pressure between rolls and rolled material. Knowledge of the distribution of pressure in rolling is of importance inasmuch as it is closely related to the flow of material. It is noted that the actual conditions cannot be found and represented by calculations. GN (12c)

The Cold-Rolling Book (Kaltwalzbuch). Edited by Martin Boerner. Martin Boerner Verlag, Halle-Saale, 1929. Paper 6 x 9 inches, 100 pages. Price 6.50 RM.

This has been compiled with the coöperation of A. Pomp, F. Heinrich, W. Quick, E. Schelisch and O. Saltmann. It is a rather elementary and practical discussion of the ordinary cold-rolling process for steel. The description of the change of properties by cold-rolling and annealing is the most technical part of the brochure. High roll pressure and high rolling speeds are advocated, with very heavy rolls and great care in lubrication and cooling. This is considered better engineering than the American practice of continuous rolling. Rapeseed oil plus 15% flake graphite is advocated for bearing lubrication.

Erichsen testing is briefly discussed. The book ends with "Ten Commandments for the Cold-roller," dealing with care of the rolls and precautions in the process, and tells the workman that if he observes these commandments he will aid in allowing Germany to compete with foreigners and hence retain his own job. Tables showing pass reductions for different conditions are appended.

H. W. Gillett (12c) -B-

The Basis of Continuous Seamless Tube Rolling Mills without Mandrel (Ueber die Grundlagen kontinuierlicher Rohrwalzwerke ohne Dorn. Reduzierwalzwerke). G. B. Lobkowitz. *Stahl und Eisen,* Vol. 51, Nov. 12, 1931, pages 1389-1397; Nov. 19, 1931, pages 1432-1437.

Report 90 of the Rolling Mill Committee of the Verein deutscher Eisenhüttenleute. Includes discussion. 6 references. After describing the 3 various types of reducing mills for rolling small size seamless tubes, the general principles are considered which this type of mills must fulfill. They are as follows: Seamless tube reducing mills differ from other continuous mills inasmuch as the increase of rolling speed of subsequent passes cannot be made strictly correspondent to the decrease of cross-section. The speed of rolls must be regulated so that a pull is always exerted between 2 subsequent passes. The amount of this necessary pull can only be determined by experiment. An approximate method of calculating the excess of speed from pass to pass is given. The distance of subsequent passes decidedly affects the wall thickness of the tubes and must be chosen so that a uniform wall thickness is guaranteed. An attempt has been made to determine, by calculation, amount and distribution of the changes of wall thickness during the rolling process under the supposition of uniform reduction, uniform pull and uniform increase of wall thickness. The deformation process of the 3 various rolling methods was studied and the forces apparent in the cross-section are diagramatically shown as to amount and distribution. The above considerations lead to the following requirements which reducing mills should meet for successful operation. (1) Largest reduction per pass with smallest increase of wall thickness and smallest cooling of material. (2) Avoiding of slip in the passes. (3) Admissibility of every length and thickness of tube. (4) Only driven passes. (5) Smallest number of reducing passes. (6) Shortest distance of subsequent passes. (7) Careful installation of rolls. (8) Correct adjusting of rolls. (9) Small wearing of rolls. (10) Regulation of speed. GN (12c)

Drawing & Stamping (12h)

The Construction and Uses of Typical Dies. Part V. Edward Heller. *Metal Stampings,* Vol. 4, May 1931, pages 431-432.

The author describes and illustrates the design, construction and operation of 2 types of inverted drawing dies, one for drawing cup-like parts and one for deep drawing combined with blanking and piercing operations. JN (12h)

Protective and Safety Devices on Stamping Machines (Schutz und Sicherheitsvorichtungen an Stanzereimaschinen.) H. Haake. *Zeitschrift Verein Deutscher Ingenieure,* Vol. 75, Oct. 31, 1931, pages 1349-1355.

Various constructions are described and illustrated. Ha (12h)

The Use of Compressed-Air Pressure Plates for Non-Ferrous Metal Working. O. Kühner. *Metal Industry,* London, Vol. 38, May 29, 1931, pages 545-547.

Among the advantages of using compressed-air pressure plates instead of spring pressure plates for cutting and cupping in one operation is the constant pressure plate thrust enabling the selection of more satisfactory drawing proportions. See *Metals & Alloys,* Vol. 2, Jan. 1931, page 12. PRK (12h)

The Design of Simple Bending Dies. Ellsworth E. Clark (Westinghouse Elec. & Mfg. Co.). *Metal Stampings,* Vol. 4, May 1931, pages 395-398, 413-414.

Describes and illustrates dies for producing "L", "V", and "U" bends, short bends and closed bends such as collars, loops and ferrules in sheet metal stamped parts. The author advocates the complete planning of all press tools on the drafting board. JN (12h)

The Drawing Qualities of Sheet Steel. Thos. Dockray. *Metal Stampings,* Vol. 4, Nov. 1931, pages 893-894.

The various tests for ascertaining the qualities of a deep-drawing steel are reviewed and the properties of a steel in relation to the treatment and working are discussed. From tests made, the following conclusions were reached. No correlation was found between the variations of mill cold rolling and the subsequent aging. Above 15% of the sheets showed no variation in Erichsen value in a period of 3 mos.; about 5% showed a slight increase; the remaining 80% showed a decrease up to 12% of the original value. The center of the sheet which contained the most chemical segregation showed the largest proportional decrease. After a certain period of maximum decrease was reached, an increase occurred until the original was reached. Rockwell values varied to the same extent as the Erichsen, but in no constant relation. Often the Rockwell hardness of a given sheet remained practically the same while the Erichsen value varied greatly. Low and high C content did not seem to make any difference. Ha (12h)

Die Construction for Plastic Drawing of Sheet Steel. *Metal Stampings,* Vol. 4, Dec. 1931, pages 996-997.

Paper read and discussed before the American Society for Steel Treating, Sept. 1931. See "Plastic Drawing of Sheet Steel into Shapes," *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 19. Ha (12h)

The Drawing of Wire and its Further Treatment (Drahtzieherei und Drahtverarbeitung). A. Bahls. *Dinglers Polytechnisches Journal,* Vol. 346, Sept. 1931, pages 145-150.

The technique of wire drawing with old types and recent machinery equipment is discussed and data concerning the average output are presented.

Auxiliary machines for straightening and cutting are discussed with reference to their design, mode of operation and economy. EF (12h)

Measurement on the Degree of Orientation in Hard-Drawn Copper Wires. W. A. Wood. *Philosophical Magazine and Journal of Science,* Series 7, Vol. 11, Feb. 1931, supplement, pages 610-617.

An investigation is made of the degree of orientation across the section of hard-drawn copper wire and of the way these measurements differ as the wire is further drawn, and a method is described whereby the degree of orientation may be estimated with the aid of a photometer. A core effect is found to exist; a non-oriented layer encloses an oriented core and the line of demarcation is quite sharp. The results are discussed in connection with the mechanical action of dies. Ha (12h)

Cold Working (12j)

The Effect of Cold-Working on the Magnetic Susceptibility of Metals. K. Honda & Y. Shimizu. *Kinzoku no Kenkyu,* Japan, Oct. 1931, pages 565-582.

The effect of cold-working on the magnetic susceptibility of metals has been studied systematically and may be summarized as follows: The effect of internal stress on the magnetic susceptibility of 10 metals belonging to the cubic system, that is, Cu, Ag, Au, Pb, Al, Pt, Rh, Pd, Mo and Ba, was measured. The magnetic susceptibility of diamagnetic metals that is, Cu, Ag, Au and Pb, decreases by compression. In the case of Cu, its susceptibility is changed from diamagnetic to paramagnetic by compression. The magnetic susceptibility of paramagnetic metals, viz., Al, Pt, Rh, Pd, Mo and Ba, also decreases by compression. The relation between the changes in density and magnetic susceptibility is linear. The temperature effects on the magnetic susceptibility of Pt and Rh are just the opposite of each other, but the effect of the internal stress on the same quantity in the two metals is the same. KT (12j)

Polishing & Grinding (12l)

Paraffin Oil as Lubricant, Cincinnati Grinders, Inc. *Abrasive Industry,* Vol. 12, Oct. 1931, page 26.

Data pertaining to the use of paraffin oil as a grinding lubricant are given. The heavier oils that were originally tried out were too expensive and left too great a residue on the work. The lighter non-viscous oil such as kerosene was too penetrating and had a comparatively low flash point which made the fire hazard rather high. A light paraffin oil served the purpose well, kept the wheel open, and overcame all of the above mentioned objections. WAT (12l)

Care in Polishing for High-Grade Finish, Cadillac Motor Car Co. *Abrasive Industry,* Vol. 12, Oct. 1931, pages 33-36.

Polishing and buffing operations are described and illustrated. WAT (12l)

DEFECTS (13)

Worn Tires and Split Switch Tongues. (Abgenutzte Radreifen und klaffende Weichenzungen.) CAESAR. *Organ Fortschritte des Eisenbahnwesens,* Vol. 86, Mar. 1, 1931, pages 138-143.

The danger of worn tires when passing switches is pointed out particularly for internationally running railroad cars It is attempted to determine how far a wheel can be allowed to wear down to pass safely the tongues of switches. Ha (13)

Crankshaft Fracture in Air Traffic. (Kurbelwellenbrücke im Luftverkehr.) E. EVERLING. *Automobiltechnische Zeitschrift,* Vol. 35, Jan. 10, 1932, pages 22-23.

A statistical review of crankshaft fractures in the last years reveals the fact that the most likely place for a fracture is where a sudden change of section occurs; seldom are defects of material the case. The shape of the fracture points to torsional vibrations. To avoid this cause a simple strengthening of the shaft would not do because of mechanical reasons; the better way is to prevent resonant oscillations by making the shaft hollow. A change of sequence of ignition will sometimes help. The most effective means to prevent fractures of shafts are damping devices for the oscillations consisting mainly in a mass rotating with the shaft but being able to change its position with respect to the end of the shaft. By properly dimensioning mass and friction the resonance curve can be almost entirely smoothed out. It is strongly emphasized that this problem is never a question of material but always of resonance. Ha (13)

Cracks in Circumferential Seams of Water-gas Welded Drums. (Risse in Rundnähten von wassergasgeschweissten Trommeln.) HERMS. *Die Wärme,* Vol. 54, Sept. 12, 1931, pages 682-688.

The formation of cracks after three months' service was noticed in gas welded circular seams of four vertical tube drums. The course and depth of the cracks was determined by drilling and chipping and the repair work is described. EF (13)

Pinholes in Aluminum Castings. NATIONAL SMELTING COMPANY. *American Metal Market,* Vol. 38, Apr. 23, 1931, pages 4, 10.

Printed in *Bulletin* of The National Smelting Company, Cleveland. In non-technical language gives causes of pinholes with practical remedies for removal. DTR (13)

Attempt of a Systematic Classification of Casting Defects. (Versuch einer systematischen Einteilung der Gussfehler.) G. GIERDZIEJEWSKI. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Dec. 4, 1931, page 922.

A distinction is made between outer and inner scrap; the outer depends on the inner. The defects are divided into 10 classes: errors of dimensions, rough surfaces, dirtiness of the sand, interruption during pouring, bubbles, pipes, coldwelding and cracks, inclusion of slag, segregation, errors in composition. The reasons for these defects are also divided in 10 classes: design, pattern or ingot mold, molding sand, mold and cores, evaporation of water in the mold, construction of the mold, melting process, pouring technique, the metal, miscellaneous. Ha (13)

CHEMICAL ANALYSIS (14)

The Practice of Absorption Spectrophotometry. F. TWYMAN. Adam Hilger, Ltd., London, 1932. Cloth, 6 x 9¾ inches, 80 pages. Price 5s 3d.

The precise measurement of the intensity at any given wavelength of the light transmitted by a material provides information which is often quite useful. In atomic and molecular theory, and, in chemical analysis, use is being made of such information.

This little book is intended as a guide to the technique of absorption measurement in the visible, ultra-violet and infra-red regions of the spectrum. It unfortunately treats only instruments made by the publisher. There is no index.
H. W. Russell (14)-B-

Recent Applications of Absorption Spectrophotometry. Adam Hilger, Ltd., London, 1932. Cloth, 6 x 9¾ inches, 44 pages. Price 3s 6d.

A bibliography prepared as a supplement to the Practice of Absorption Spectrophotometry. The literature cited is, in the main, merely classified not abstracted.
H. W. Russell (14)-B-

A Study of the Electrolytic Determination of Copper in the Presence of Platinic Ion. T. LEONARD KELLY & JOSEPH J. MOLLOY. *Journal American Chemical Society,* Vol. 53, Apr. 1931, pages 1337-1341.

It has been found that the Pt deposits not only over the Cu but through it, causing an increase in weight of the cathode. It is, therefore, recommended that the cathode be weighed after the Cu is dissolved off, instead of weighing before the deposition, in order to obtain the true weight of the cathode. The effects of certain elements on the use of diethyl dithiocarbamate as an indicator for Cu are given.
MEH (14)

Lead, Antimony and Tin Alloys. MAX. HALE. *Chemist-Analyst,* Vol. 20, Mar. 1931, page 10.

The specific gravity of Pb-Sb alloys containing not more than .5% Sn indicates the approximate composition. For analysis .5 g. is decomposed with HNO_3 and neutralized with NaOH until the precipitate redissolves. The solution is poured into 5% NaHS solution and boiled for one hour. The precipitate is filtered, washed with NaHS and dissolved in HNO_3 and H_2SO_4. Pb is determined as $PbSO_4$. 4-5 g. KCN is added to the filtrate from the sulphide precipitation and Sb is electro-plated on Pt electrodes at 3.5-4 volts. The remaining solution is acidified with acetic acid and Sn precipitated with H_2S, ignited and weighed as SnO_2. CEM (14)

The Colorimetric Determination of Minute Amounts of Cadmium. LAWRENCE T. FAIRHALL & LEON PRODAN. *Journal American Chemical Society,* Vol. 53, Apr. 1931, pages 1321-1323.

A colorimetric method for the determination of minute amounts of Cd is described; in it advantage is taken of the intensification of color of the sulphide under ultraviolet rays. A sensitivity of 1:2,500,000 is obtained and an accuracy of 4% in the analysis of material containing from 0.40 to 1.00 mg. of Cd in 100 g. of organic material. MEH (14)

HISTORICAL & BIOGRAPHICAL (15)

Early Forges & Furnaces in New Jersey. CHARLES S. BOYER. University of Pennsylvania Press, Philadelphia, 1931. Cloth, 6 x 9¼ inches, 287 pages. Price $5.00.

The author is president of the Camden County Historical Society, and has been collecting the information contained in this volume for the past 20 years. The treatment is primarily historical, but some interesting metallurgical comments are included.

Little is known about the first New Jersey furnace, the Shrewsbury furnace, established about 1675-1680, but there are good records of several built around 1725. It was known about 1750 that some of the local ore beds were too high in sulphur while others produced cold-short iron, i. e., were too high in phosphorus. By 1825 or before, ores were evaluated for suitability for iron-making by chemical analysis, made by Professor Silliman at Yale. The analyses cited are reported to even percents, except for "phosphate of iron," of which three ores contained 1, 1½ and 2%. Cast pipe, first ordered from Weymouth furnace in 1801 for the Philadelphia water works, was tested at the works, and there was plenty of scrap. Cast iron grave markers made at Weymouth are said to have withstood the weather for 100 years with little signs of rusting, a quality claimed by the early iron founders for iron from bog ore. The author states that he has a piece of bog iron cast at Martha furnace which has lain out in the weather for 10 years without a trace of rust.

The present Taylor-Wharton Iron & Steel Company plant at High Bridge, is the direct successor of the old Union Iron Works, established before 1750, and is located on part of the original tract, the Taylor family having been manufacturing iron and steel at that location for over 150 years.

The services of the various forges and furnaces in making munitions for the Revolutionary War and that of 1812 are interestingly described.

Photographs of the ruins of some of the old furnaces, of cast iron stoves, etc., add to the interest of the volume.

The printing and binding are excellent.

Metallurgists interested in the historical aspects of their science will welcome this book, though fuller discussion of the metallurgical problems and difficulties involved might well have been included. H. W. Gillett (15)-B-

Development of Tungsten Carbide Die. L. C. JACOBSON. *Wire & Wire Products,* Vol. 7, Jan. 1932, pages 18, 26-28.

An outline is given of the difficulties surmounted in the development of the carbide die from its inception to its present use in drawing special shapes. Ha (15)

Michael Faraday, Early Metallurgist. Correspondence from F. G. MARTIN, Birkenhead, England. *Metal Progress,* Vol. 20, Dec. 1931, pages 77-78.

The writer gives a short account of the metallurgical contributions of Michael Faraday. WLC (15)

The Story of the Nickel Industry. A. J. WADHAMS (International Nickel Co.). *Metals & Alloys,* Vol. 2, Sept. 1931, pages 166-175.

The author recounts the history of the development of the nickel deposits of Ontario with interesting details of the part of many individuals in this development. WLC (15)

The Ten Years of the Kaiser Wilhelm-Institut für Metallforschung. (10 Jahre Kaiser Wilhelm-Institut für Metallforschung.) G. MASING. *Zeitschrift für Metallkunde,* Vol. 23, Dec. 1931, pages 321-322.

The foundation and development of the institute are described. The efforts of the institute have been chiefly in two fields: (1) the application of X-rays to physical and metallurgical problems in metals and alloys, (2) the study of the behavior of single crystals. RFM (15)

A Research on Faraday's "Steels and Alloys." ROBERT HADFIELD. *Philosophical Transactions of the Royal Society of London,* Series A, Vol. 230, pages 221-292.

Faraday left a number of steel specimens on which he experimented. On the occasion of his 100th birthday they were subjected by the author to present day analysis and testing of physical properties, the results of which are given in this highly interesting report. The means Faraday had at his disposal are described, and the tests made consisted in chemical analysis, determination of hardness, metallographic examination, resistance to corrosion, specific magnetism, forging properties, determination of critical temperature ranges, thermal expansion, electrical resistance, and tensile tests. Among the 76 specimens were alloys with Cr, Ni, Cu, Au, Ag, Pt, Rh, Pt + Ag, Ag + Au, Ni + Au. Much of our present knowledge is anticipated in the research work of Faraday.
Ha (15)

Cast Iron Pipe 260 Years Old in France. BURT B. HODGMAN. *Journal American Water Works Association,* Vol. 23, May 1931, pages 673-677.

The author describes his visit to Versailles, France, and his inspection of the pumping plant and piping of the Versailles Gardens. The pipe is of cast iron, installed between 1664 and 1685 and is the oldest known. It is approximately 20 ins. in diameter, cast in lengths of 2 meters and flanged. The pipe in places is laid underground outside the tunnel and at other places runs along on the floor of the tunnel. It is in good condition. VVK (15)

Notes on a Research on Faraday's Steels and Alloys. ROBERT HADFIELD. *Engineer,* Vol. 152, Sept. 25, 1931, page 319.

Abstract of paper read before Section G of the British Association for the Advancement of Science, London, Sept. 24, 1931. LFM (15)

Dinanderie, Early Copper and Brass Work. *Metal Progress,* Vol. 20, Oct. 1931, pages 93-96.

Historical, of the mediaeval ornamental work in brass at Dinant, Belgium. WLC (15)

Oxy-Acetylene Welding and Cutting. *Industrial Gases,* Vol. 12, Mar. 1931, pages 41-43.

Makes brief historical note on this important industrial process. DTR (15)

MISCELLANEOUS (20)

Rectification in the Copper-Oxide Cell (Le redressement dans les éléments a oxide de cuivre). R. Jackelet. *Revue Générale de l'Electricite*, Vol. 30, Sept. 5, 1931, pages 365-372.

The theory developed by the author for the explanation of the rectifying action of Cu against copper oxide is based on tests which seem to point to a distortion of the crystal which it assumes in the oxidation furnace. The dissymetry thus produced in the crystals would explain the dissymetric action against the passage of alternating currents. Ha (20)

The Profiles of Chords of Welded Girders (Ueber die Profile der Stäbe geschweisster Fachwerkträger). H. Kayser & C. J. Hoppe. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Oct. 3, 1931, pages 1251-1254.

The results of tests on girders which were made to give a comparison between the strengths of girders as dependent on their construction, rivets, gussets, chord section by measuring the deflection, tensions and breaking loads and also to compare the weights and manufacturing conditions of 4 different constructions of pipes and of profiles. The T-sections were the least satisfactory; pipes gave a good saving in weight. The omission of gusset plates and T-sections gave the least weight. The tests prove that, for welding, new sections and pipes can be used to very great advantage, especially pipes because they have a greater moment of inertia and are, therefore, more resistant to buckling. They can also be welded in angular joints. Ha (20)

The Demonstration of Calculations of Strength in the Welding Technique. (Ueber die Verauschaulichung von Festigkeitsrechnungen in der Schweisstechnik.) Otto Mies. *Die Schmelzschweissung*, Vol. 11, Jan. 1932, pages 1-3.

The method of explaining and making a certain phenomenon in one field of theoretical physics more comprehensible by a similar phenomenon in another field which both have the same mathematical expression, and which has been very fruitfully used by Kirchhoff, Lord Kelvin, Prandtl and Foeppl, is discussed and illustrated by an example of the stresses occurring in a welded ship's shaft, which has a slight irregularity in its section. The influence on the magnitude of the stresses is found by a hydro-mechanical analogue; it is shown that the distribution of shearing stresses follows the same law as the velocity of rotating water in a pipe of circular section. Ha (20)

Parallel Operation of Turbo-Blowers. (Parallelbetrieb von Turbogäsen.) R. Landsberg. *Stahl und Eisen*, Vol. 51, Aug. 27, 1931, pages 1077-1080; Sept. 17, 1931, page 1179.

The parallel operation of turbo-blowers, even of different characteristics, does not offer any difficulties. If the speed remains constant the turbo-blower adjusts itself without exterior regulation to the new conditions brought about by operating another blower in parallel to it on the same pipe line. It is, therefore, sufficient to automatically regulate only one of several blowers working on a common system. Ha (20)

Rebuilding Track under Heavy Traffic. LeGarde. *Electric Railway Journal*, Vol. 75, Dec. 1931, pages 685-688.

Reconstruction of 8,136 ft. of track on Market Street, San Francisco. By efficient mechanical and labor organization, the job was completed in 24 working days. Welding of joints was made by the thermit process. CBJ (20)

Industrial Policy as Affecting the Iron and Steel Industry. Wm. J. Larke. *Foundry Trade Journal*, Vol. 45, Nov. 5, 1931, pages 283-285.

Address at a meeting of the Midland Coördinated Metallurgical Societies, in which the author reviews post-war conditions and the relationship between British policy and the trade depression. OWE (20)

Logical Safety Methods Bring Higher Production. George Laidler. *Canadian Foundryman*, Vol. 22, Oct. 1931, pages 11-14.

An article, accompanied by 1 photograph and 2 tables, in which the various methods that can be adopted for improving safety conditions in factories are discussed in some detail. OWE (20)

Means for a Calculation of Strength which is True to Reality. (Wege zu einer wirklichkeitsgetreuen Festigkeitsrechnung.) Ernst Lehr. *Zeitschrift Verein Deutscher Ingenieure*, Vol. 75, Dec. 5, 1931, pages 1473-1478.

The conceptions of "degree of safety" and "permissible stress" are today still not absolutely definite. Recent investigations show that a calculation of the actually occurring stresses is possible only if the strength-reducing influences are taken into consideration from case to case. These influences can be divided into 2 groups: 1. Those concerning the material itself, injury to surface, corrosion, temperature, kind of stress, defects in manufacture; 2. Influence of shape and of service (notch effects due to design, overstressing). Although the determining material properties, as for instance, endurance limits and alternating stress strength, are sufficiently well known it has not been possible to transmit the results of sample rods to parts of considerable dimensions. To do this the author makes concrete suggestions: static measurements of elongation with defining of zones of maximum stress, dynamic measurement of elongation for the determination of the actually occurring effect and its temporal course, decomposition of the maximum observed stress into two components, one constant and one superimposed alternating force; from these data the material satisfying the requirements is selected. The true safety margin can then be determined according to whether the respective part must be considered as the vital factor or as a replaceable part in the whole structure. 19 references. Ha (20)

American Mining Law. A. H. Ricketts. California State Printing Office, Sacramento, 1931. Limp leather, 5 x 8 inches, 811 pages. Price $2.00.

This is a concise exposition of American mining law. It is very complete, and is undoubtedly authoritative. It is well printed on thin paper and bound in leather. We doubt if the price charged covers the cost of printing and binding. HWG (20)-B-

The Cupola Furnace. J. E. Hurst. *Foundry Trade Journal*, Vol. 45, Nov. 19, 1931, pages 316-318.

An article in which the value of the cupola furnace as an economical unit is emphasized. The cardinal points in melting practice are discussed and the necessity for maximum fuel economy is stressed. The importance of escaping-gas composition and temperature are dealt with. The relationship between maximum thermal efficiency, melting rate, and critical blast volume receives some consideration. Attention is directed to the balanced blast cupola and the value of the increased flexibility of air-supply control of this type of cupola is emphasized. The paper closes with a table showing the costs of producing malleable cast iron in various types of melting equipment. A report of the discussion of the paper follows. OWE (22)

An Engineer's View of the Foundry. Henry Gardner. *Foundry Trade Journal*, Vol. 46, Jan. 7, 1932, pages 7-11.

A discussion of the features in foundry practice of particular interest to engineers: (1) furnaces, (2) melting practice, (3) molding sands, (4) molding appliances and handling equipment, and (5) defective castings. Some attention is directed to the machinability of cast iron, and considerable space is devoted to the effect of core design upon castings. A description of various methods of sand-molding and of molding equipment and handling appliances are given. The article is illustrated by 20 photographs. OWE (22)

Determine Clay Content by Short Method. E. C. Cunningham. *Foundry*, Vol. 59, Nov. 15, 1931, pages 43-44.

Abstract of a report to the Wisconsin Gray Iron Group—Sand Committee on the adoption of a modification of the present American Foundrymen's Association method of clay substance determination in molding sand. The principal advantages of the modified method are: elimination of syphoning and refilling operations and a more uniform application of wash water. VSP (22)

To Produce Better Cast Iron, Standardize Materials and Practice. J. L. Heffron. *Canadian Foundryman*, Vol. 22, Nov. 1931, pages 5-10, 22.

Paper read before the Montreal Chapter of the A.S.S.T. at the opening meeting of the Fall Session, in which a description of the production of better grades of cast iron by improved cupola practice and mixtures and by standardizing raw materials is dealt with in considerable detail. OWE (22)

More Pig Iron for Better Castings. J. E. Hurst. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 77-78.

Recommending the use of more pig. The reduction in Si and Mn and the increase in S and combined C brought about by the remelting of No. 1 pig iron is shown. The relation between character of initial Fe and the effect of remelting is brought out. CHL (22)

Making Large Bells For a Carillon. *Iron Age*, Vol. 129, Jan. 21, 1932, pages 230-231, 250.

Describes the casting of carillon for the Riverside Drive Church at the Croydon Bell Foundry, Croydon, England. Molds are built up largely by hand and are set in pits. Outer cope is formed in specially designed cast Fe case. After casting, metal is allowed to cool for one or two days, depending on size. When taken from sand, the casting is sand blasted, the gate and header trimmed off. Each bell is tested and tuned for five principal tones. VSP (22)

New Ingot Metal Standards. *Metal Industry*, New York, Vol. 29, Dec. 1931, pages 517-518.

Tables are given listing the chemical compositions of copper base alloys in ingot form for sand castings with approximate physical properties and notes on uses, foundry manipulation and machining characteristics. This is part of tentative specification B 30-31 T of the American Society for Testing Materials. PRK (22)

Foundries, Large and Small. *Metallurgist*, Sept. 1931, pages 129-130.

The arguments for and against a foundry in connection with any individual company to supplement their needs are reviewed with the conclusion that only in the largest establishments is such a foundry efficient, satisfactory or justified. VVK (22)

The Magnetic Moulder. *Foundry Trade Journal*, Vol. 46, Feb. 4th, 1932, pages 89-91.

A description of an electrically operated molding machine which has no motor attachment and which requires neither compressor nor hydraulic plant for its working, the entire operation being magnetic in nature. The article is accompanied by 1 diagram and 1 photograph. OWE (22)

Sands and Sand Testing. J. G. A. Skerl. *Engineering*, Vol. 132, July 3, 1931, page 10.

Abstract of a paper read before the Institute of British Foundrymen, June, 1931. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 23. LFM (22)

The Use of Flexible Couplings in Foundries. *Foundry Trade Journal*, Vol. 46, Feb. 11, 1932, pages 103-104.

A brief description of the value of employing flexible couplings for connecting machines and motors and avoiding troubles due to misalignment. Some consideration is given to methods for avoiding end thrust and to points that should be observed in mounting machines for service. OWE (22)

Foundries Requiring Clearer Conception of Gray Cast Iron. Oliver Smalley (Gray Iron Institute). *Steel*, Vol. 88, Feb. 12, 1931, page 42.

Advances in the gray iron industry during 1930 include the control of graphitization and carbide formation in castings as a result of better theoretical conceptions, improvements in operation and in the control of products by the adoption of standard procedures, the application of heat treating methods to gray castings resulting in increased tensile strengths, thus permitting their use for the manufacture of oil quenched machinery parts, tool parts and die parts, and the development of a new and superior corrosion-resistant gray cast iron. JN (22)

FURNACES & FUELS (23)

Modern Developments in Blast Furnace Stoves. T. P. Colclough. *Iron & Steel Industry & British Foundryman,* Vol. 5, Dec. 1931, pages 97-101.

The theories of heat transfer as applied to the checkerwork in blast furnace stoves are interestingly discussed. The advantages gained by the use of varying sizes of fillers in the checkerwork of the Brassert stove so as to increase the volume of the fillers from the top to the bottom of the stove and at the same time maintain the velocity of the gas are discussed. Stoves of the new designs operate with an overall efficiency of over 85% while those of the old design ranged from 50 to 60% in overall efficiency. CHL (23)

The Path of Gases in the Coke Oven. (Der Weg der Gase im Koksofen.) P. Damm & F. Korten. *Glückauf,* Vol. 67, Oct. 24, 1931, pages 1339-1345; *Stahl und Eisen,* Vol. 51, Nov. 19, 1931, page 1437.

Report 38 of the Coking Plant Committee of the Verein deutscher Eisenhüttenleute. At any one moment the coking charge can be divided into preheating zone, plastic zone, semi-coke zone. In each of these, a degasification takes place depending on the type of coal and also on the coking conditions. The volatile matter of the preheating zone migrates to the center of the oven whereas that of the coking zone migrates to the hot walls of the oven. Very little is known of the path of the gases coming from the plastic zone, but the location of this zone in the oven affects the output of by-products, since gases migrating to the hot walls are immediately dissociated. GN (23)

Successful Open-Hearth Operation with Coke Oven Gas. A. J. Ebner (Freyn Engineering Co.). *Blast Furnace & Steel Plant,* Vol. 19, Nov. 1931, pages 1459-1461.

Hoesch Steel Works, Dortmund, Germany, has improved design of open hearth furnaces so that only coke-oven gas is burned. The slag pockets have been the same width as the regenerator chambers and both have a center dividing wall and double arched roofs. A single uptake tapers from a wide opening centrally over the slag pocket, narrowing as it rises to the furnace port. A double burner is provided at each furnace end, each burner receiving gas through a water-sealed gooseneck which permits easy adjustment of burner positions. Use of single air uptake and short furnace head with constricted port produces a high air velocity concentrated at the point of admixture with the gas and results in exceptionally good turbulence and effective flame. Average consumption of gas (527 B.t.u./ft.^{3}) based on actual time of heats from tap to tap on all furnaces is 8390 ft.^{3}/ton of steel. Furnaces are old and do not have the advantages of modern structural improvements. Bricks used average 24 lbs./ton of steel. Water cooling of doors, frames and ports requires an average of 1580 gals./ton of steel. Average production rate on three 100-ton furnaces is 15½ tons/hr. Hearth load is 68 lbs./ft.^{2}/hr. Checker brick is renewed after 1200 heats. Other plants are adopting this type of furnace. MS (23)

The Use of High Frequency Furnaces in the Laboratory (Ueber die Verwendung von Hochfrequenzöfen im Laboratorium). W. Kroll. *Metallwirtschaft,* Vol. 10, Sept. 25, 1931, pages 751-754.

The relative advantages of 2 high frequency electric furnaces for laboratory use are discussed, a Lorenz generator type of 8000 cycles and 4 kw. and a Ribaud spark gap type of 60,000 cycles and 12.5 kw. The generator type is simpler to operate on account of the low voltage required, 100 to 200. The 8000 volts required for the spark gap type makes it more expensive and necessitates perfect insulation between the crucible and furnace and crucibles do not last as long as at lower voltages. In the generator type, 400 g. electrolytic Fe can be melted in 25 mins. with 11 kw., in the spark gap type, 800 g. with 12.5 kw. Too rapid heating must be avoided in the generator type, to prevent local overheating. The spark gap is placed in a box because of its noise and nitrous fumes. Metals with low conductivity and metallic powders can be melted in the spark gap type, but it is better to compress powders into briquettes. Cold Si cannot be melted in either type but at 1000° C. it has enough conductivity to be melted in the spark gap type. Mg and Al cannot be melted in the generator type, but can in the spark gap type. High frequency furnaces are ideal for alloying purposes and produce a thorough mixing action. Metals can be melted under H, A, or in a vacuum. Aluminothermic and magnesio-thermic reactions can be carried out: Pb and Sn can be separated, pure Ca can be produced by distillation, and easily oxidized metals can be melted under A. Quartz is used as a seal against air. Alundum forms a very good crucible material and can be used up to 2000° C. CEM (23)

PC

Economy and Thermal Efficiency of Modern Electric Furnaces for Annealing Metals. (Wirtschaftlichkeit und thermischer Wirkungsgrad neuzeitlicher Elektroöfen zum Glühen von Metallen.) H. Masukowitz. *Zeitschrift für Metallkunde,* Vol. 23, Nov. 1931, pages 306-309; Dec. 1931, pages 335-337.

Fuel costs (producer gas, electricity), heat losses, and general thermal efficiency of annealing furnaces are discussed. Special insulation and construction affords high efficiency. Design of continuous furnaces for annealing metal strip; shaft, pot, and muffle furnace for annealing pipes and rods are described and their economy and thermal efficiency are discussed. RFM (23)

Conditions of Pressure and Draft in the Open-Hearth Furnace. (Druck-und Zugverhältnisse im Siemens-Martin-Ofen.) M. J. Lackner. *Stahl und Eisen,* Vol. 51, Feb. 12, 1931, page 205.

The distribution of pressure and draft in the different parts of the open-hearth furnace, including stack, were studied; the results are tabulated and some conclusions drawn for the arrangement of the chambers, ports, channels, etc. Ha (23)

Technical and Practical Requirements of Modern Forge Furnaces. Wm. Lehrer & A. B. Barber. *American Gas Association Monthly,* Vol. 13, June 1931, pages 250-253.

Based on the work of Jominy, a special type of gas fired furnace has been developed for heating forgings. Temperature and atmosphere are important considerations in this process. High temperatures cause burning of steel and destruction of refractories. The scale formed peels off and, reacting with refractories, produces a low melting flux that may cling to the metal and cause a defective forging. Automatic temperature control enables operation below the melting point of the scale. In oil firing the scale produced is soft and loose whereas in the ordinary gas forge it is hard and sticky and acts as an abrasive on the dies. Soft scale gives about double the die life. Figures are given showing detailed savings. The amount of scale formed depends upon the time of exposure, the temperature and the furnace atmosphere whereas the type of scale is determined entirely by atmosphere. To obtain a fast heating rate, the heat transfer may be obtained best by the flame itself rather than from a high thermal head. Therefore a luminous flame is essential. An atmosphere of 2-3% CO does not prevent scaling; it merely decreases the rate. To prevent scaling the reducing gases must be 4 times as great as the oxidizing. If reducing gases are CO and hydrocarbons, the steel will carburize, thus lowering the melting point and causing pitting. The less scale formed, the smoother the finished forging. Steels containing less than 1% C can be safely heated to a higher temperature in a reducing atmosphere than in an oxidizing atmosphere. Work leading to the development of "diffusion flame combustion" furnaces by the Surface Combustion Corp. is described. In this type the inter-diffusion of gas and air which issue from the burner in separate layers mix the gases at a slow rate. The hydrocarbons crack into H and free C which, heated to incandescence, is the source of luminosity which is equal to that of an oil flame. An emissivity factor as high as 0.6 has been secured. The rate of heat transfer is proportional to emissivity, thus permitting rapid heating with low temperature differential. The burner and furnace are designed to obtain a parallel flow of reacting gases. This makes it possible to provide a raw duct so that the steel while being heated is blanketed in raw gas thus making it possible to produce a forging practically scale free. Preliminary tests show a heating rate of at least 150 lbs./ft.^{2} of hearth/hr. as against 100-120 lbs. in oil fired furnaces. RJC (23)

Furnaces for Burning Blast-Furnace Gas. Otto De Lorenzi. *Blast Furnace & Steel Plant,* Vol. 19, Jan. 1931, pages 135-139, 142.

Burner design, furnace design, preheating of air and firing methods in furnaces for burning blast-furnace gas are described. The change from other gas-heated furnaces consisted in inverting the furnace and firing from the bottom instead of from the top. Experiences with 3 installations which have given good results are given. Ha (23)

Steel Furnace Repairs. Walter Lister. *Metallurgia,* Vol. 5, Nov. 1931, pages 17-18 and 28.

Detailed directions for repairing the port ends of open-hearth furnaces are given. JLG (23)

Gas in Industry (Das Gas in Gewerbe und Industrie). H. Lent. *Gas und Wasserfach,* Vol. 74, Sept. 19, 1931, pages 873-877; Sept. 26, 1931, pages 905-908.

The speaker at the 72nd General Meeting of the Deutscher Verein von Gas- und Wasserfachleuten, June 1931, Breslau, is particularly concerned with the great advances of gas firing as a coming competitor of electric heat in industry. Attention is focussed upon the characteristics and the advantages of both kinds of heat applied to industrial furnaces. Stress is laid on the difficulties met in the utilization of electricity at temperatures higher than 1300° C. After a general discussion of the subject, the author takes up the various types of gas-fired furnaces all of which, except one, belong to the metallurgical industry. The features of the different furnaces of German design are discussed at length and abundantly illustrated. EF (23)

Rules for Comparing the Economy of Purification Plants of Blast Furnace Gas. (Richtlinien für den Wirtschaftlichkeits-Vergleich von Hochofengas-Reinigungsanlagen.) F. Lüth. *Archiv für Eisenhüttenwesen,* Vol. 5, Nov. 1931, pages 223-230.

Report 123 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute. 9 references. Descriptions are given of gas purification by wet, dry, and electro-cleaning, which are about equally effective. By the last 2, a gas of 60°-80° C. can be obtained, containing 60-150 g./m.^{3} of vapor. With an additional cooler, they can furnish also a saturated gas of 20°-30° C. corresponding to the wet cleaning process. The individual parts of the various methods and the necessary conversion to attain a common basis of comparison are discussed. The comparative total cost of purification for wet, dry and electro-cleaning was respectively 0.7623, 0.5029, and 0.3213 marks/1000 m.^{3} of dry gas during the month of comparison, and 0.2728, 0.2681 and 0.3001 at 100% utilization. GN (23)

Transformers for Electric Furnaces. (Les Transformateurs pour Fours Electriques). M. G. Marty. *Journal du four electrique,* Vol. 39, Oct. 1930, pages 378-380, 415.

See *Metals & Alloys,* Vol. 2, Jan. 1931, page 16. (23)

Electric Heating Furnaces Find Place in Steel Mills. A. H. Vaughan. *Steel,* Vol. 89, July 30, 1931, pages 34-36.

Car type, pit type and continuous furnaces for annealing, normalizing and heat treating are described briefly. Ha (23)

The Present Status in the Construction of Resistance Furnaces for Industrial Purposes. (Die gegenwärtige Lage im Bau von Widerstandsofen für industrielle Zweecke.) V. Paschkis. *Elektrotechnische Zeitschrift,* Vol. 53, Jan. 14, 1932, pages 25-27; Jan. 21, 1931, pages 58-62, 66-70.

The materials used in resistance furnaces up to 1500° C., their shapes and the construction of units and the assembly of units as used in modern furnaces are discussed, charging devices are described and sources of heat losses and their magnitude are discussed. Ha (23)

REFRACTORIES & FURNACE MATERIALS (24)

Refractories. F. H. Norton. McGraw-Hill Book Company, New York, 1931. Cloth, 6 x 9½ inches, 594 pages. Price $6.00.

The author is Assistant Professor of Ceramics, Massachusetts Institute of Technology, and in addition to his teaching has done a large amount of research and development work in the refractories field. In this volume a complete, detailed, and concise description is given of refractories from the occurrence of raw materials to the testing of the finished product. Sufficient information is given of each department of refractories manufacture to give the student a complete picture of the subject. In addition the large selected bibliographies at the end of each chapter provide an easy method for the student to secure further and more detailed information.

The metallurgist will find of particular value the chapter on the measurement of high temperatures and the sections describing the factors that influence load bearing capacity, spalling, and slagging of refractories and the methods for measuring them.

Two chapters are devoted to a discussion of the use of the microscope and the X-ray in the study of refractories. Although space did not permit the author to make these chapters exhaustive, they give an excellent introduction to these subjects and point to future possible developments in these methods of study.

This volume provides a complete and up-to-date publication on refractories which should prove to be extremely useful to both the producer and the user of refractories.

C. E. Williams (24)-B-

Investigations of the Reversible Heat Expansion of Refractories (Untersuchungen über die umkehrbare Wärmeausdehnung feuerfester Steine). A. Kanz. *Stahl und Eisen*, Vol. 52, Jan. 7, 1932, pages 18-19; *Mitteilungen Forschungs Institut der Vereinigten Stahlwerke*, Vol. 2, 1931, Report No. 5, pages 77-96.

Refractories either expand or contract during burning, but the coefficient of heat expansion can be made reversible either by repeated burning or by burning at sufficiently high temperatures. The investigation method of Steinhoff & Nopitsch (*Tonindustrie Zeitung*, Vol. 51, 1927, pages 918- 920, 1011-1013, 1047-1049) was used to measure the reversible heat expansion of 10 different fire-clay bricks, 15 silica bricks, 2 samples of quartz slate, 12 samples of magnesite bricks, 32 samples of special refractory bricks and 32 samples of artificially made quartz free clay. The limit values of the mean linear coefficient of heat expansion are given in the table below. The coefficient depends largely on the temperature, but for most of the materials tested, it increased linearly with the temperature. An exception to this rule are the bricks containing free silica. With fire clay bricks containing quartz and silica bricks, faulty burning causes considerable variations of the coefficient of heat expansion, as well as a difference in behavior between case and core of the bricks. Silica bricks show a relation between specific gravity and coefficient of heat expansion.

Material	Mean linear coefficient of heat expansion between 200° and 1000° C.
Fire clay bricks	5.54- 6.81 $\times 10^{-6}$
Quartz fire clay bricks	4.99- 6.29 $\times 10^{-6}$
Quartz free fire clay bricks (own make)	4.40- 5.09 $\times 10^{-6}$
Silica bricks	12.72-15.41 $\times 10^{-6}$
Quartz slate brick	18.29-18.65 $\times 10^{-6}$ (1st test)
Quartz slate brick	10.09 $\times 10^{-6}$ (2nd test)
Magnesite bricks	13.74-14.53 $\times 10^{-6}$
Magnesia mass	13.86-14.48 $\times 10^{-6}$
Chromite bricks	7.27- 9.08 $\times 10^{-6}$
Bauxite bricks	5.19- 6.51 $\times 10^{-6}$
Corundum bricks	5.58- 7.03 $\times 10^{-6}$
Sillimanite bricks	4.95 $\times 10^{-6}$
Zirconium bricks	5.01- 5.66 $\times 10^{-6}$
Carborundum bricks	4.37- 5.42 $\times 10^{-6}$

GN (24)

Relative Heat Transfer Through Refractories. A. S. Watts & R. M. King. *Engineering Experiment Station Bulletin* No. 64, *Ohio State University*, 1931, 32 pages.

The methods by which heat is transferred and the laws governing these methods are reviewed; the mathematical expressions for the determination of heat conductivities of refractory materials are discussed. The samples consisted of 9" straights, 2.5" thick, and 9" splits, 1.25" thick of a great number of chemically different materials and were tested at hot face temperature of 800° and 1000° C. The method permitted an accuracy of 10%. It can be stated that the surface greatly influences the heat-transfer; many factors affecting the heat transfer have seldom been taken into consideration, which accounts for unreliable values of commercially fabricated pieces. Heat transfer can be only roughly correlated with chemical composition and physical properties of the pure crystal, but other factors such as porosity, surface effects and the heterogeneity of the mass must be considered. The factors to be considered are: 1. the technique of measurement, 2. the physical properties of the pure crystal, 3. the surface properties of the test piece, 4. the porosity of the test piece. In an appendix the test method used is critically analyzed, and a list of 81 bibliographical references is added.

Ha (24)

Manufacture of Refractories Tends Toward Uniformity. H. M. Kraner. (Westinghouse Elec. & Mfg. Co.) *Steel*, Vol. 88, Jan. 22, 1931, page 47.

Minor developments in the refractory industry for 1930 include definite improvements in size and shape control of clay refractories and a greater degree of uniformity in quality and methods of manufacture. Satisfactory bonding materials have been achieved for use with zircon and magnesia furnace linings and superior patching materials have been developed from a study of the system, $CaO-MgO-Fe_2O_3$.

JN (24)

Refractories in Metallurgical Operations. Clyde E. Williams. (Battelle Memorial Institute) *Metals & Alloys*, Vol. 3, Jan. 1932, pages 3-11.

22 references are cited. As over ⅓ of the refractory brick used in industry go into open-hearth furnaces the refractory problems in this furnace have been subject to extensive studies. The necessity for high mechanical strength require silica brick for the roof. Causes of failure due to spalling with temperature changes and slagging action of the oxide particles carried in the gases are discussed. The improvement of the life of roof brick by use of thicker brick and by insulation are discussed. Normal life is about 300 heats which is capable of considerable increase to over 600 by application of thicker roof, combustion control and insulation. The lack of satisfactory mechanical properties in neutral and basic brick requires judicious arrangement for their use in side walls. The cutting action of the acid slag dripping from the roof also must be considered. Building up a sloping back wall of bottom material in the basic furnace has advantages. Silica brick in ports are protected from corrosion by oxide particles by covering of magnesite or chrome cements. High-alumina clay refractories have been used satisfactorily in water cooled ports. The problem of slagging and clogging action in checker work is discussed and the properties required of the firebrick used for this application. In the acid open hearth furnace the corrosive action and slagging of the bottom with iron oxide offers the chief difference from the basic bottom. Resistance to metal penetration and chemical attack by molten metal and slag of high FeO content is necessary in ladle linings which are briefly discussed. The large quantity of refractory necessary to make a blast furnace lining even tho it lasts for several years of continuous operation makes the selection of refractories important. The qualities of fire-brick for this use vary with the severity of service encountered in the zones of the furnace, hearth, bosh, shaft, and top. Special problems in refractories for heating furnaces, cupolas, copper smelters, air furnace, arc and induction furnaces are similar to those met in the open hearth and are briefly discussed under these headings. The temperature conditions are usually less severe except in the case of steel melting in arc and induction furnaces.

WLC (24)

GASES IN METALS (25)

The Heat of Absorption of Hydrogen by Palladium Black at 0°. Louis J. Gillespie & Henry A. Ambrose. *Journal of Physical Chemistry*, Vol. 35, Nov. 1931, pages 3105-3110.

The authors have measured the loss of energy attending the absorption of H by Pd black, using an ice calorimeter. The loss of heat content found for the reaction $H_2 + 4\ Pd = 2\ Pd_2H$, where Pd_2H gives the average composition of the 2 solid phases formed, is 9280 cal_{15}.

OWE (25)

On the Correct Experimental Method for Establishing the Independence of the Hydrogen Content and the Hardness of Electrolytic Iron (Sur la méthode expérimentale propre a établir l'indépendance de la teneur en hydrogene et de la dureté du fer électrolytique). Guichard, Clausmann, Billon & Lanthony. *Comptes Rendus*, Vol. 193, Nov. 31, 1931, pages 1084-1085.

A further contribution to the discussion of this problem, the authors criticizing the experiments that had been carried out by Guillet, Roux and Cournot (*Comptes Rendus*, 1931, Vol. 193, page 685). See following abstract.

OWE (25)

New Observations Relative to the Influence of Occluded Gases on the Mechanical Properties of Metallurgical Products (Nouvelles remarques relatives á l'influence des gaz occlus sur les propriétés mécaniques des produits métallurgiques). Leon Guillet, Albert Roux & Jean Cournot. *Comptes Rendus*, Vol. 193, Oct. 26, 1931, pages 685-687.

A further contribution to the discussion of the controversial question of the relationship between the hardness of electrolytic metals, and iron in particular, and their hydrogen content. The authors support the view that this hardness is a function of the hydrogen content of the material, while Guichard and his collaborators believe it to be a function of the grain size of the material. The experiments which the authors describe, involving the extraction of hydrogen from samples of cathode iron by treatment in vacuo at various temperatures, lead them to a repetition of their former view that it is impossible to establish the fact that the hardness of electrolytic iron is entirely independent of the hydrogen content.

OWE (25)

Effect of Hydrogen Sulphide on Wire Rope. L. W. Vollmer & B. B. Wescott (Gulf Research Labs.) *Transactions American Society Mechanical Engineers*, PET 52-7, Oct. 1930, pages 39-45.

The embrittlement of wire rope used in drilling oil wells in fields where H_2S is present, was forcefully brought out by experience in the West Texas field where the gas contains 15% H_2S. The fractures were intercrystalline, and showed strong similarity to those due to H embrittlement from pickling. Likewise, the degree of embrittlement declined on standing. A hard drawn 0.7% C wire exposed to moist H_2S, would stand only 30% as many revolutions at a certain stress in a rotary bending test of the type used by Langdon and Grossman (*Transactions American Electrochemical Society*, Vol. 37 (1920) page 543) as would the unexposed wire, i.e., it was 70% embrittled. On standing for a day, the embrittlement declined to 13%, and in a week, to 6%. Gentle baking (400° F. for 3 hours) will practically remove the trouble. The maximum attainable degree of embrittlement in hard drawn steel increased with the degree of cold work, and was not related to C content. On long exposure, a protective film was formed and recovery, i.e., diffusion out of H, outran damage, i.e., taking up of H. In annealed wire, Armco iron was more embrittled (80%) than high C, and the maximum degree of embrittlement in the other wires was fairly constant at from 25 to 45%, irrespective of C content. The embrittlement was ascribed to adsorbed atomic H. It was concluded that the adsorption of atomic H increases as the purity of the ferrite increases. The intergranular ferrite in the high C steels is considered purer than in ingot iron. Prevention of contact between H_2S and the rope, by galvanizing, by lead or copper coating, or to some degree, by lubrication of the rope, is advised. Tin is worthless as a protective coating.

HWG (25)

Nitrogen in Mild Steel. *Metallurgist*, Apr. 1931, pages 51-53.
A review of the work of Köster in *Archiv für das Eisenhüttenwesen*, Vol. 4, Dec. 1930, pages 289-294. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 152. VVK (25)

Hydrogenized Iron. P. P. Cioffi. *Bell Laboratories Record*, Vol. 10, Jan. 1932, pages 159-163.
Iron heated in hydrogen at 1400°-1500° C. for 18 hrs. and subsequently annealed below 910° C. produces iron with a maximum permeability of 140,000, or 18 times that of ordinary annealed iron. The maxima do not occur at the same value of magnetizing force. At 0.04 gauss, the permeability is 500 times, and initial permeability is 20 to 50 times that of ordinary iron. The hysteresis loss at a flux density of less than 200 ergs/cm.^{3}/cycle, is 1/16 that of ordinary iron, and is but 1/3 that of permalloy. Water vapor must be present in the hydrogen. Carbon is removed in the hydrogen treatment, and about one atom of hydrogen to 1000 atoms of iron is retained, but the exact mechanism of the action is in doubt. Ha + HWG (25)

Oxides in Aluminum. *American Metal Market*, Vol. 38, Aug. 13, 1931, pages 4, 10.
. Reprinted from bulletin of International Smelting Co. Certain effects such as cores in castings, excessive shrinkage, low fluidity, high surface tension and poor machinability indirectly serve as causes for the presence of oxides in aluminum. Proper smelting procedure will produce metal with low oxide effects, either with material first produced from oxide ores or secondary aluminum. Strict control of melting temperatures, proper use of the right fluxes and use of certain highly specialized process will give the lowest heat control. Effect of high oxides may be produced in the foundry by overheating the metal, by improper addition of gates and sprues, by bad melting practice and by churning air into the metal while it is being poured. The paper points out: (1) that there is no satisfactory direct method of determining fine oxides in aluminum and (2) that statements regarding oxides in aluminum should be carefully weighed because the trouble may not be oxides after all. DTR (25)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

On the Influence of the Alloying Elements Nickel, Silicon, Aluminum and Phosphorus on the Solubility of Carbon in Liquid and Solid Iron (Ueber den Einfluss der Legierungselemente Nickel, Silizium, Aluminium und Phosphor auf die Löslichkeit des Kohlenstoffs im flüssigen und festen Eisen). E. Söhnchen & E. Piwowarsky. *Archiv für Eisenhüttenwesen*, Vol. 5, Aug. 1931, pages 111-121.
In melting electrolytic iron in a Tammann furnace and carburizing it by sugar carbon and Acheson graphite, a preliminary alloy of about 4.27% C, 0.05% Mn, 0.025% P, 0.024% S and traces of Si was made; by adding ferrosilicon (98%) cube nickel, technical aluminum and ferrophosphorus (23%), alloys were obtained which were cast into bars, 20 mm. in diameter in sand molds. With these bars the effect of the above elements upon structure, total C content, graphite content and Brinell hardness was studied. Further experiments were carried on to establish quantitatively the effect of Al upon the C solubility in liquid state. Up to Al content of 3%, Al displaces C more effectively than does Si but, above 3%, Si is more effective. By means of a quenching method in vacuum, the solubility of C in Fe as well as this solubility in the presence of Ni, Si, Al, Si and Ni together and Si and P together was studied. The results on the quenching tests of the pure Fe-C alloys are tabulated below and indicate, in comparison with investigations of other authors, that the graphite solubility line takes its course at higher C contents than has previously been assumed.

Temperature °C	Total carbon content %	Graphite content %	Combined-carbon content %
800	4.25	3.19	1.06
	4.40	3.41	.99
900	4.84	3.54	1.30
	4.78	3.55	1.23
1000	4.28	2.80	1.48
	4.10	2.58	1.42
1100	4.38	2.54	1.84

The displacement of C by the above alloying elements decreases in the following order: P, Si, Ni. No reliable results as to this point could be obtained with Al, probably because of the oxidation of this element, since it could be verified by analysis that a large amount of the Al added did not go into solution but remained as Al_2O_3. Phosphorus contents up to 0.5% do not affect the C solubility. The results of the quenching tests of the samples containing up to 2% Si and 4% Ni show that the C-displacing effect of these 2 elements is governed by an additive law. GN (27)

Alloy Cast Iron. *Metallurgist*, Oct. 1931, pages 156-157.
An extended abstract of a bulletin on "The Development and Present Position of Nickel Cast Iron in Engineering Practice" issued by the Bureau of Information on Nickel. Ni may be alloyed with cast iron in all proportions. Like Si, it promotes graphitization and, therefore, prevents thin sections from becoming chilled and consequently too hard to machine; at the same time, it does not lower the hardness or tensile strength of the thicker sections. The effect of Cr in cast iron is to stabilize the carbide, thus producing an increased tendency to chill. In this respect, therefore, Cr is unlike Ni, although both elements combine to give uniformly increased hardness and resistance to impact and wear. In order to obtain a completely martensitic cast iron, either 6 or 7% of Ni or the equivalent in Ni and Cr may be added or a lesser amount of these elements followed by an oil or air hardening treatment. Under certain conditions, the presence of even small quantities of Ni and Cr may improve the heat and corrosion-resisting properties of gray or white cast iron; whereas, if added in larger quantities, thus rendering the iron austenitic, the improvement in these properties is most marked. 6% Si will confer increased resistance to oxidation at high temperatures while a larger amount will render it almost immune to attack by acids. Mo, V and Ti appear to strengthen cast iron and to exercise a refining action upon the graphite. VVK (27)

Useful Properties are Afforded by Manganese Steel. D. H. Young (Amer. Manganese Steel Co.). *Steel*, Vol. 88, Feb. 19, 1931, pages 51-52.
Abstract of a paper read before the National Western Metal Congress, San Francisco, Feb. 16-20, 1931. JN (27)

The Influence of Various Additions on the Properties of Gray Cast Iron. (Einfluss verschiedener Sonderbestandteile auf die Eigenschaften des Graugusses.) *Die Metallbörse*, Vol. 21, Feb. 21, 1931, pages 340-341.
36 references. The influence of the following elements on gray cast iron is summed up: Cu, Pb, Mg, Mo, Bi, B, Ca, Ce, Sb, As, Co, V, Zn, Zr, Sn, Ti, W, U. EF (27)

Effects of Small Amounts of Copper, Nickel, and Cobalt on the Oxidation Reactions of Iron. (Einfluss kleiner Mengen von Kupfer, Nickel und Kobalt auf die Oxydationsvorgänge beim Eisen.) Hubert Kirscht. *Stahl und Eisen*, Vol. 52, Jan. 21, 1932, page 71; Doctor's thesis, University of Münster, 1931, 28 pages.
After reviewing work author points out that Fe forms an endless series of mixed crystals with Ni and Co, but this is not the case with Cu. Increasing amounts of Cu, Ni, and Co were added to Fe, the non-ferrous metals being prepared from their oxides by reduction with H. After complete removal of H, which required heating at least 10 days in vacuum, at 900° C., measured amounts Co_2 were added. Equilibrium condition was allowed to take 3 to 6 days and resulting gas mixture analyzed. The solubility of O in the Fe is thus given and the O pressure of the oxidized Fe may be calculated. Addition of Cu, Ni and Co decreases solubility of O in Fe and also causes a rise in O pressure. O solubility in pure Fe at 800° C. is 0.5%, while with alloys it is 0.05%; alloys of Cu, containing 0.5% Cu, showed maximum effects, the O pressure decreasing with increasing Cu content. The following table shows effect of additions to oxygen pressure of oxidized iron.

	Addition	%	Temp. °C.	Composition of Gases of Reaction % CO_2	% CO	Relative O Pressure, referred to Pure Fe as 1.000
Pure Fe	...	...	700	40.2	59.8	1.000
	Cu	0.1	700	40.8	59.2	1.052
	Cu	0.25	700	41.2	58.8	1.086
	Cu	0.5	700	41.2	58.8	1.086
	Cu	1.0	700	40.9	59.1	1.059
	Cu	4.0	700	40.6	59.4	1.034
	Ni	4.0	700	41.3	58.7	1.096
Pure Fe	...	...	800	34.8	65.2	1.000
	Cu	0.5	800	35.8	64.2	1.062
	Ni	0.5	800	35.8	64.2	1.062
	Co	0.5	800	35.8	64.2	1.062
Pure Fe	...	...	900	31.2	68.8	1.000
	Cu	0.5	900	32.1	67.9	1.053

HWG+GN+DTR (27)

INSTRUMENTS & CONTROLLERS (28)

Fundamentals of Instrumentation. M. F. Behar. Instruments Publishing Company, Pittsburgh, 1932. Cloth 6 x 9¼ inches, 109 pages. Price $2.00.
This introductory book, though Part One of the author's "Manual of Instrumentation," is self-contained. It opens with a preface presenting in an inimitable manner the value of control in industry through the use of instruments *i. e.*, "instrumentation." He predicts "the early recognition of Instrumentation as a distinct branch of engineering, and as a distinct field of scientific management." The line of development is outlined as first such re-design of one apparatus or another as to make such and such a condition measurable—and then controllable.
The book presents the definitions of the various terms, and classifications of the fields of use of instruments, and of the instruments themselves. It describes the various elements that compose instruments, and discusses the possibilities of accuracy of the measurements by various means, and deals with the performance of the more complicated instruments by the use of which control of various conditions may be secured.
The reviewer extends a most hearty welcome to this book, the first attempt that he has seen to bring in a complete form, into one volume, an understandable presentation of the fundamentals of measurement and control, herein called instrumentation. He will make one excerpt only from the preface, hoping thereby best to present the appeal of the present volume: "The production man, whatever be his official title and whatever branch of engineering he may practice, is the one for whose particular benefit these handbooks are written. It had to be so, for the main purpose of industrial instruments is to aid production, to subserve the application of efficiency principles, 'highest quality at lowest production cost,' and the other maxims of scientific management."
A brief résumé of the contents best illustrates the scope of this book as a guide to better solution of production problems through measurement and control. Chapter I, on Industrial Instruments, contains such subheads as "Classification (of Instruments) by Function," and "Principal Parts of Industrial Instruments." Chapter II treats of "Properties and Characteristics of Industrial Instruments." "Performance of Controllers" is the subject of Chapter III, and Chapter IV is a symposium on "The Plant Instrument Department."
In conclusion, it seems to the reviewer that this book might well have been named "The Philosophy and Fundamentals of Instrumentation." It puts into practical form the author's philosophy "that the outstanding characteristic of industrial instruments is that they yield tangible and practical dividends," thereby presenting to the busy production man the fundamental information about instruments in a way that makes it readily available and easily understandable. S. L. Goodale (28)-B-

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Non-Ferrous Alloys. Part I. Copper, Brass, Bronze, Red Brass (Nichteisen Metalle). R. HINZMANN. No. 45 of Simon's Werkstattbücher. Julius Springer Verlag, Berlin, 1931. 56 pages. Price 2 RM.

Condensed information as to properties of these alloys. Most of the data are elsewhere available, though here collected in handy form. Some data on short-time tensile tests at high temperatures are included, as follows: Tensile strength is in lbs./in.^{2}, elongation, % in two inches.

Material	A		B		C		D		E		F		G	
Temp. °C.	T.S.	El.	T.S.	El.	T.S.	El.	T.S.	El.	T.S.	El.	T.S.	El.	T.S.	El.
20	32,500	3	57,000	55	51,000	33	42,500	45	90,000	21	34,000	36	32,500	18
100	...	...	43,000	50	...	...	42,500	40	...	...	34,000	35	32,500	20
150	...	...	...	...	...	...	42,500	35	...	...	...	...	...	...
200	...	...	37,000	40	...	...	...	...	...	...	31,000	39	31,000	17
250	...	...	...	...	...	...	38,500	15	47,000	40	...	...	...	...
300	15,500	12	24,000	13	34,000	13	...	...	35,000	47	20,000	11	22,500	7
350	...	...	...	...	28,500	10	28,500	5	25,500	60	...	...	...	...
400	8,000	12	17,000	25	15,500	15	...	...	...	...	8,500	0	15,500	14
420	...	...	...	...	...	...	...	...	10,000	59	...	...	...	...
450	5,500	14	...	...	14,000	20	...	...	...	...	...	...	...	...
475	...	...	...	...	...	...	...	...	7,000	51	...	...	...	...
500	3,500	21	...	...	7,000	22	...	...	...	...	5,500	0	8,500	0
510	...	...	...	...	...	...	...	...	5,500	48	...	...	...	...
535	...	...	...	...	...	...	...	...	3,400	106	...	...	...	...
700	...	...	...	...	...	...	...	...	2,100	162	...	...	...	...

	Composition							
	Cu	Sn	Pb	Zn	Mn	Al	Fe	Ni
A—Casting Brass	57	...	0.1	Bal.				
B—Hard Brass	58	...	2.0	Bal.				
C—Forging Brass	60	...	0.4	Bal.				
D—Brass	70	...	...	30				
E—Manganese Bronze	55.1	0.77	0.52	41.9	0.36	0.07	0.84	0.28
F—Cast Red Brass	93	4	1	2				
G—Cast Red Brass	85	9	...	6				

It is stated that Cu-Mn alloy with 5 to 6% Mn, of 45,500 to 51,000 lbs./in.^{2} tensile, 85 Brinell, 35 to 39% elongation, used for staybolts, does not lose strength till the temperature is over 300° C. H. W. Gillett (29)-B-

The Plasticity of Metals. ZAY JEFFRIES. *Scientific Monthly,* Vol. 33, Sept. 1931, pages 235-243.

Plasticity is the quality by virtue of which a substance may undergo a permanent change in shape without rupture. In many non-metallic plastic materials the flow is essentially fluid. During the deformation the solid particles move bodily and the liquid conforms to the new shape. The mechanism of the plastic deformation of metals is quite different. Metals are crystalline and plastic flow is the result of block movement of one portion of the crystal with reference to another, the movement being along crystallographic planes. Since hardness is measured by resistance to plastic deformation, and methods or treatments designed to change hardness constitute a large part of the metal art, plasticity assumes a major role on the metallurgical stage. The study of the plastic deformation of single crystals of various metals and X-ray crystal analysis have greatly enriched our knowledge in the past 15 years. Realizing the extreme softness of single crystals of metals and the very slight changes in hardness with change in temperature, at least within certain temperature limits, it seems remarkable that the mere aggregation of differently oriented single crystals can result in the properties offered by poly-crystalline metals. A Mo wire composed of a series of single crystals had the same strength (30,000 lbs./in.^{2}) in the temperature range 100°-900° C., whereas a finegrained Mo wire had its strength reduced from 115,000 lbs./in.^{2} when tested at 100° C. to 70,000 lbs./in.^{2} at 900° C. A single crystal of W can be bent at room temperature, but in liquid air the elastic limit is enormously increased and fracture occurs without any noticeable deformation. Coarse-grained Mo more than trebles its tensile strength under similar conditions. Face-centered cubic metals retain their plasticity at liquid air temperatures. In general the body-centered cubic metals do not retain their plasticity at low temperatures as well as face-centered metals. Hexagonal rhombohedral metals like Bi and Sb become very brittle at temperatures not far below their freezing points. Fine-grained and coarse-grained commercial wrought Zn at liquid air temperature shows no plasticity. A single crystal of Mg, however, shows considerable plasticity at -190° C. Again Be becomes non-plastic well below room temperature. The author urges upon physicists the potentiality of the study of plastic deformation in metals as a means of unlocking some doorways to nature's secrets of the internal structure and properties of solids. WAT (29)

New Uses for Bolts Demand Higher Standards of Manufacture. F. O. KICHLINE. *Steel,* Vol. 89, Oct. 26, 1931, pages 31-33, 38.

Bolts for railroads and high-pressure purposes are now made of special steels, one a low carbon Ni-Cr, the other a Cr-W; analysis and treatment are described in detail, physical tests made extended also to creep tests over 1000 hours at 1000° F. The characteristics are tabulated. Ha (29)

Heat-Resisting Alloys. J. FERDINAND KAYSER. *Foundry Trade Journal,* Vol. 45, Dec. 31, 1931, pages 412, 414.

After dealing with the properties required in heat-resisting alloys, the author deals with the subjects of oxidizing and reducing atmospheres, respectively, pointing out that reducing atmospheres containing sulphur dioxide and hydrogen sulphide are the most dangerous with which heat-resisting alloys have to contend. Some attention is given to the phenomenon of creep and to the effects of repeated heating and cooling on heat-resisting alloys. The history of the evolution of heat-resisting alloys is dealt with briefly, the article closing with a description of recent heat-resisting cast irons. OWE (29)

The Scaling and Corrosion of Steel for Steam Boilers and Superheaters. *Quarterly of the British Electrical and Allied Industries Research Association,* Feb. 20, 1931, J/E/T 14, pages 13-23.

With O-free steam the corrosion due to the rate of reaction between steam and steel superheaters is negligible for steam temperatures up to 427° C. and tube temperatures up to 510° C. In the absence of free O, scaling is definitely lessened by the use of fuel low in H. The use of Enduro KA2 superheater tubes with temperatures on the fire side up to 650° C. is not limited by the reaction between Fe and steam. H gas evolution is accelerated by O entering the system with the feed water. Within limits the alkalinity of the boiler water will have no noticeable effect on the rate of reaction between Fe and steam. A definitely alkaline boiler water and feed water is preferred to prevent corrosion and limit corrosion due to other conditions. However, alkaline water does not stop corrosion due to O. Free C in a smoky atmosphere has a negligible effect in preventing scale formation. Caustic embrittlement is retarded by the presence of sodium sulphate and the action is dependent on the sulphate concentration. Chromate in small concentration has a similar effect but there is a consumption of chromate owing to the oxidation of H. The embrittling effect of magnesium chloride at 310° C. is diminished by the addition of sodium sulphate or potassium chromate. The value of electro-deposited coatings of metals such as Ni and Cr as preventatives of corrosion is of interest as no practical applications of this nature are recorded, in boiler practice, at the present time. The thickness of the plated metal and the particular metal to be used in a particular service is of extreme importance. WAT (29)

Embrittlement of Steel by Molten Metals. *Metallurgist,* July 1931, pages 107-109.

An extended review of the work reported by H. Schottky, K. Schichtel & R. Stolle in *Krupp'sche Monatshefte,* Vol. 12, May 1931, pages 100-105. See "The Red-Brittleness of Steel by Metals," *Metals & Alloys,* Vol. 2, Sept. 1931, page 193. VVK (29)

Creep Determination on Structural Steels at High Temperatures. *Metallurgist,* June 1931, pages 85-86.

Extended abstract of a paper by Pohl, Scholz and Juretzek in the *Archiv für Eisenhüttenwesen,* Vol. 4, Aug. 1930, pages 105-110. See *Metals & Alloys,* Vol. 2, Feb. 1931, page 51. VVK (29)

Nickel-Cobalt-Iron Alloys. *Metallurgist,* Oct. 1931, pages 153-154.

An extended abstract of *Technical Publication* No. 430, *American Institute Mining & Metallurgical Engineers* by C. R. Austin & G. P. Halliwell. See "Some Developments in High-Temperature Alloys in the Nickel-Cobalt-Iron System," *Metals & Alloys,* Vol. 2, Dec. 1931, page 326. VVK (29)

High Temperatures Impose New Demands on Steels. *Steel,* Vol. 88, Feb. 19, 1931, page 46.

A report of the fifth midwest power engineering conference and the fourth national fuels meeting of the American Society of Mechanical Engineers, held in Chicago, Feb. 10-13, 1931. JN (29)

Some Alloys for Use at High Temperatures. Complex Iron-Nickel-Chromium Alloys. Part III. C. H. M. JENKINS & H. J. TAPSELL. *Engineering,* Vol. 131, May 29, 1931, pages 713-714, 716; *Iron & Coal Trades Review,* Vol. 122, June 12, 1931, pages 944-945; June 19, 1931, pages 986-987; June 26, 1931, pages 1016-1017.

Condensed from Communication from the National Physical Laboratory, read before the Iron & Steel Institute, London, May 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 284. LFM + Ha (29)

Thermal Expansion of Heat Resisting Alloys: Nickel-Chromium, Iron-Chromium, and Nickel-Chromium-Iron Alloys. PETER HIDNERT. *Bureau of Standards Journal of Research,* Vol. 7, Dec. 1931, pages 1031-1066; *Bureau of Standards Research Paper* No. 388.

This paper gives data on the linear thermal expansion of various heat resisting alloys (Ni-Cr, Fe-Cr and Ni-Cr-Fe). The alloys contain 0-77% Ni, 5-27% Cr and 0-82% Fe. The coefficients of expansion of the alloys were determined for various temperature ranges between 20° and 1000° C., and the effects due to temperature, chemical composition, heat treatment, etc., were determined. Critical regions were located on the thermal expansion curves of some of the alloys. For a given temperature range, the coefficients of expansion of Ni-Cr alloys containing from 0 to about 20% Cr are nearly the same. The effects of Cr content, C content, heat treatment, etc., on the coefficients of expansion of Fe-Cr alloys for various temperature ranges are indicated in a single figure. The results on the thermal expansion of Ni-Cr-Fe alloys were correlated with the structure of the alloys. Transformations from one phase to another caused significant changes in thermal expansion. The expansion curves on the first heating of nearly all of the cast Ni-Cr-Fe alloys indicated a retardation or decrease in expansion between 700° and 800° C., due to precipitation of the carbide. The effects of change of composition on the coefficients of expansion of both cast and annealed Ni-Cr-Fe alloys are indicated. The table gives a comparison of the expansion of the 3 groups of alloys.

	Chemical Composition		
Alloys	Ni	Cr	Fe
Group 1 Ni-Cr	76.8-77.0%	19.3-20.4%	
Group 2 Fe-Cr		17.0-24.6%	74.0-81.7%
Group 3 Ni-Cr-Fe	1.3-70.1%	4.9-26.7%	6.6-74.7%

	Average Coefficient of Expansion per ° C. $\times$ 10^{-6}		
Alloys	20°-100°	20°-500°	20°-1000°
Group 1	13.0-13.6	14.7-15.1	17.2-17.8
Group 2	10.0-10.6	11.2-11.7	12.5-13.1*
Group 3	8.7-18.4	11.3-18.9	13.1-20.6

*20°-900° C.

In the report the above values were given for every 100° increments, the accompanying table is presented only to give some idea of the changes. WAT (29)

High-Temperature Creep Properties of Wrought Carbon and Low-Alloy Steels. A. P. Spooner (Bethlehem Steel Company) & F. B. Foley (The Midvale Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 368-393.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 193. In discussion data are given from the U. S. Bureau of Standards on short-time tensile tests and Charpy impact tests on two rail steels (1) 0.69% C, 0.70% Mn and (2) 0.59% C, 1.30% Mn. These data are from a study of the blue brittleness or secondary brittleness known to exist in steels in the neighborhood of 300° C. In discussion from the Crane Company it is stated that, while it is now generally admitted that at temperatures where creep is a factor, no true elastic limit is determinable for the purpose of design, nevertheless, there is a temperature range, up to 600° F., for heat-treated alloy steels, in which short-time test data are quite as valid as at ordinary temperatures. It is in the temperature range above 700° F. that delicate extensometers start to show uncertain proportional limit values, and where creep data begin to be at variance with short-time tensile values. It is also suggested (International Nickel Company) that more attention be given to structural stability of metals at elevated temperatures. The aging effects (decrease in notch toughness and ductility, increase in hardness, and changes in rate of chemical attack) initiated by cold work are important in parts which are fabricated prior to elevated temperature service. Data taken from the work of Pomp and Bayer indicate that steels containing Ni do not show as great a tendency toward aging embrittlement or grain growth as do plain C steels. Several three-dimensional diagrams illustrate this feature. From the University of Michigan are data indicating that the proportional limit does correctly portray the creep characteristics corresponding to 1% flow in 100,000 hours within a definite temperature range. This temperature range is generally just below the lowest temperature of recrystallization, or the equi-cohesive temperature of the given alloy. If the given temperature is too far below the lowest recrystallization temperature, then strain hardening may occur and the creep strength is considerably above that indicated by the proportional limit. If the given temperature is too far above the lowest recrystallization temperature, then, under long periods of time, the deformation occurs around the crystals rather than in them and the results indicated by the proportional limit are too high. The data presented indicate that short-time or accelerated creep tests do not give an accurate indication of the actual creep characteristics of a metal. High C steels are superior to low C steels in their ability to withstand the continued application of stress, at least to 850° F. These conclusions are based on both short time tensile and creep tests. The thought of a number of other discussions, however, is that the C content is not the only factor in plain C steels controlling the elevated temperature strength. The other usual elements present and the process of manufacture are also equally as important as the carbon content. Tabulated data from the General Electric Company show the stresses producing a flow rate of 1% in 100,000 hours, between 400° and 550° C. for 12 C and alloy steels. In the authors' closure it is emphasized that a satisfactory short-time method for determining elevated temperature properties of metals is still needed. WAT (29)

Engineering Requirements and Trends for Metals in the Ferrous Metal Industries. J. C. Woodson (Westinghouse Electric & Manufacturing Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 112-150.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 193. In the discussion it is pointed out that imperfect castings have probably been the greatest single cause of trouble in the service of cast furnace parts. The major portion of the discussion does not agree with the author that the problem of growth, expansion, warping and cracking is more severe with cast resistors than with the malleable or wrought elements. In high temperature work the casting of the same composition (except possibly higher carbon) will keep its shape better and be freer from warpage, than the rolled material, especially as for the same cost it will be thicker than the same composition fabricated in rolled form. Intricate shapes may be cast, while to fabricate the same shape by any other method would require welding. Despite the great progress made in welding it is still the weakest link in the chain. Another discusser also stresses the point that more research should be done on welded materials at elevated temperatures. It is further emphasized that great care should be used in defining the operating conditions to which a given material will be subjected. The use of nitrided boxes, using a 25% Cr and 20% Ni alloy, is reported as giving satisfactory service in Germany. WAT (29)

Stayrods and Firebox Plates. R. Kühnel. *Metallurgia,* Vol. 5, Dec. 1931, pages 53-56.

Translation of an article in *Zeitschrift für Metallkunde,* Vol. 23, Jan. 1931, pages 1-11. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. JLG (29)

The Strength at High Temperatures of a Cast and a Forged Steel as used for Turbine Construction. H. J. Tapsell & A. E. Johnson. *National Physical Laboratory, London, Engineering Research, Special Report,* No. 17, 1931, 33 pages.

The report contains the results of short-time tensile tests and creep tests carried out on a 0.30% C cast steel and a 0.39% C forged steel over a temperature range of approximately 400° to 650° C. Full tensile properties and the stresses corresponding to rates of creep down to 10^{-5} in./in./day have been determined. The results are given in numerous tables and curves. They show that the cast steel possesses limiting creep stresses of 10, 8, and 4 tons/in.^{2} at 400°, 450°, and 497° C. respectively while the forged steel has the values of 13, 10, and 5 tons/in.^{2} at 400°, 447°, 507° C. respectively. Ha (29)

Some Observations on the Dilation of Several Common Steels. H. E. Publow, C. M. Heath & M. E. Batchelor. *Michigan State College Engineering Experiment Station Bulletin* No. 41, Dec. 1931, 15 pages, 12 figures.

Elementary discussion of the use of the Chevenard dilatometer. Unannealed specimens from the same bars of steel gave discordant results. Carburized 0.15% C steels with 1½% Ni, ¼% Mo; 3½% Ni and 5% Ni gave less permanent shrinkage than a carburized 0.05% C plain carbon steel. A plain carbon carburized specimen 2.160" long heated past the critical 21 times, then measured 2.135". The amount lost by scaling is not stated. The decrease on each heating varied from 0.0004" to 0.0010". Ha + HWG (29)

Metallurgical Requirements for High-Temperature Steam Piping. F. W. Martin (Sargent & Lundy). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 49-65.

For abstract of paper see *Metals & Alloys,* Vol. 2, Oct. 1931, page 232. In the discussion it was stated that stresses at high temperatures producing 2 or 3% deformation in rigid portions of piping systems may produce dangerous stress combinations. It is suggested that seizing of screwed connections may be minimized by nitriding the nuts and using the differential pitch idea to avoid concentrating the load on the first few threads. The use of materials of differing thermal expansion in nut and stud may also help. An alloy containing 48.9% Ni, 29.5 Co, 8.4 Fe, 9.5 Cr, 2.4 Ti, 0.5 Al and Si, 0.2 Mn and C is recommended by Westinghouse Electric & Manufacturing Company as being a worthwhile steam piping material. At 1100° F. this material has a proportional limit of 57,500 lbs./in.^{2}, a Johnson limit of 71,300, 0.2% yield point 86,000, 0.5% yield point 85,000, tensile strength 127,000, elastic modulus 26,000,000, elongation and reduction about 20%. The Detroit Edison Company reports relatively small changes in the physical properties of 18-8 Cr-Ni steel after 6400 hours in piping operating at 700° - 1100° F. The material is subject to strain hardening, and there is a change in its microstructure due to migration of carbides to the grain boundaries. The material, however, is still quite ductile and tough, and shows resistance to sulphur attack. WAT (29)

The Mechanical Properties of Aluminum and Magnesium Alloys at Elevated Temperatures. R. L. Templin & D. A. Paul (Aluminum Company of America). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, pages 290-315.

For abstract of paper see *Metals & Alloys,* Vol. 2, Sept. 1931, page 193. In the discussion additional data are presented by the Dow Chemical Co. on three cast Mg-base alloys, containing (1) 8.1% Al, 0.2% Mn, (2) 1.92% Mn and (3) 3.8% Al, 0.34 Mn, and also on two extruded Mg-base alloys containing (1) 8.19% Al, 1.27 Cd, 2.02 Cu, 0.34 Mn, 0.47 Zn, and (2) 1.92% Mn. Short-time tensile strength values are given for these five alloys between 20° and 450° C. A brief comparison is made between a number of Mg alloys and some of the more widely used Al alloys reported in the original paper. A great similarity exists between the curves showing the effect of elevated temperatures on the tensile properties of Al and Mg alloys. Both wrought Al and wrought Mg alloys are more susceptible than the cast alloys to changes produced by elevated temperatures. The Al alloys as a class possess somewhat better tensile properties than do the Mg alloys in the temperature range of approximately 300 - 600° F. The differences in tensile properties at room temperature and at moderately elevated temperatures, due to alloy composition, heat treatment and mechanical working, largely disappear as the temperature is still further raised, so that at temperatures between 700° and 800° F. all alloys, both those of Al and Mg, irrespective of prior treatment, possess approximately the same tensile strength. WAT (29)

REDUCTION METALLURGY (31)

Present Smelter Practice—Calumet and Hecla Consolidated Copper Company. Endicott R. Lovell & Herman C. Kenny (Calumet & Hecla). *Mining Congress Journal,* Vol. 17, Oct. 1931, pages 533-538.

The entire metal content of the Calumet & Hecla concentrates is native Cu except for the Cu oxide from the ammonia leaching. Cu is too low in Ag to warrant electrolytic refining; it contains no Au whatever, and other impurities, principally As, are removed by fire refining only. From the concentrates a rich mixture, 75% Cu and a low-grade one of 40% Cu, both self-fluxing, are made. About 5% coal or coke screenings is added to each of the above mixtures, and 8% is added to CuO leached material. Smelting operation consists of (1) melting, (2) refining, and (3) casting into refined shapes. Melting is done in pulverized coal-fired reverberatory furnaces, centercharged through openings in the arch. During the melting period, the furnace atmosphere is kept slightly reducing and together with coal screenings, prevents loss of oxidized Cu in the slag. Melting furnace Cu runs 98.7% Cu, 1.0% Fe, 0.20% S, and 0.04% As. The slag runs 42.5% SiO_2, 30% FeO, 13% Al_2O_3, 8% CaO, 2.3% MgO and 0.60% Cu. Average daily melting furnace capacity is 280 tons of concentrates, 120 tons of slag and 75 tons of coal. Fe is removed in refining by throwing sand over the bath to flux Fe oxide as it is liberated. Fluid slag is skimmed off. The As is removed by blowing in from the bottom powdered soda ash and perhaps some added lime. Soda slags are very corrosive to brickwork and linings and need to be removed immediately as formed. The poling period then begins. High volatile bituminous coal with 4.5% ash and S always below 1.0% is burned. Prime Calumet & Hecla Cu analysis: Cu and Ag, 99.95%, As 0.0025%, Fe 0.0025%, Ni 0.0015, S 0.0015 and O_2 0.042%. Diagrammatic sketches of smelter and refining furnaces are shown. Melting costs per ton of concentrates are $2.80; refining costs per ton of Cu, $2.91; casting costs, $1.07 per ton of Cu. DTR (31)

Refining of Nickel According to the Orford Process. (Die Raffinade von Nickel nach dem Orfordverfahren.) THEWS. *Die Metallbörse,* Vol. 21, Sept. 5, 1931, pages 1674-1675.

The Orford process, developed by the Orford Copper Co., is based on the separation of Cu-Ni sulphides into layers when fused with Na_2S. The present operation of the process at Port Colburn, Ontario, by the International Nickel Co. is described. EF (31)

Manufacture of Chrome-Iron Alloys—"Wild" Direct Reduction Process. *Foundry Trade Journal,* Vol. 46, Feb. 11, 1932, pages 101-103.

The works of the Darlington Rustless Steel & Iron Co. are described. The process developed by Ronald Wild, of Sheffield, for the production of Cr-Fe alloys involves the direct reduction of Cr ores. The output is remarkably high, even from the viewpoint of regular steel-making practice. Details are given of the types of rustless Fe that are produced by the process. OWE (31)

Handling of Non-Ferrous Flue Dust. (Zur Behandlung des metallhüttenmännischen Flugstaubes.) THEWS. *Die Metallbörse,* Vol. 21, Aug. 15, 1931, page 1541.

Briquetting and sintering of flue dust in non-ferrous plants. EF (31)

The Treatment of White Metal Waste and Drosses. (Zur Behandlung metallischer Weissmetallkrätzen und Abzüge.) E. R. THEWS. *Die Metallbörse,* Vol. 21, Aug. 1, 1931, pages 1443-1444.

The different metallurgical methods in relation to the composition of the delivered white metal wastes and drosses are reviewed. EF (31)

Development of Gun-feed Reverberatory Furnaces at Garfield Plant of American Smelting & Refining Co. R. A. WAGSTAFF (American Smelting & Refining Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 471, Feb. 1932, 7 pages.

Finely ground, hot calcines were charged in matte furnace below the moving gas stream of the combustion zone using the gun feed. This decreased dust losses and increased furnace life over charging through the top. JLG (31)

Sintering Zinc Ore at Rosita, Mexico. H. R. MACMICHAEL (American Smelting & Refining Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 455, Feb. 1932, 8 pages.

A sintering plant that successfully handles 9,000 tons of preroasted finely ground flotation concentrates per month is described. The charge contains from 5 to 9% S, and the sinter 0.5%. JLG (31)

The Recent Development of the Coley Process. (Die moderne Entwicklung des Coley Verfahrens.) O. W. ROSKILL. *Die Metallbörse,* Vol. 21, Aug. 27, 1931, pages 1587-1588; Aug. 29, 1931, page 1637.

The latest advances of the Coley process for the production of Zn in a continuously working drum furnace, are given and experiences gain on 2 plant installations are presented. EF (31)

The System $PbO-Sb_2O_3$ and Its Relation to Lead Softening. C. G. MAIER & W. B. HINCKE (U. S. Bureau of Mines). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 449, Feb. 1932, 12 pages.

Equilibria in the system $PbO-Sb_2O_3$ were studied by thermal analyses, vapor pressure measurements and microscopic examinations. A compound, $PbO \cdot Sb_2O_3$, is formed. With increasing PbO the vapor pressure decreases until it becomes very small at 40% PbO (535° and 697° C.), thereby indicating that crystals of free Sb_2O_3 were present up to this concentration of PbO. The effects of oxidation and reduction are discussed, as well as the practical applications of the conclusions. 4 references. JLG (31)

Molybdenum Bronzes. (Zur Kenntnis der Molybdänbronzen.) W. G. BURGERS & J. A. M. VAN LIEMPT. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 202, Dec. 24, 1931, pages 325-328.

The electrolytic reduction of acid molybdate melts produces, according to the composition of the baths, a reddish-brown MoO_2 or Mo-blue. The formation of so-called Mo bronzes could not be detected. Ha (31)

The Use of Limestone in the Iron and Steel Industry. Part III. OLIVER BOWLES (U. S. Bureau of Mines). *Rolling Mill Journal,* Vol. 5, Apr. 1931, pages 247-250.

A knowledge of the occurrence, properties, and methods of quarrying and treating limestone is of value to the furnace operator in selecting a source of supply. The impurities found in a given limestone may be inherent in the rock and impossible of separation by the quarryman or they may be present merely as sand or clay and readily eliminated by careful quarrying. Various considerations such as available CaO, increased fuel cost, decreased furnace output, comparative transportation costs, etc., must be balanced in deciding on a cheaper impure CaO. Other necessary considerations are uniformity in composition of successive shipments, MgO content not exceeding 5%, and the absence of excessive amounts of impurities in the fines. JN (31)

Healthful Smelting Conditions Promote Efficiency. R. P. E. HERMSDORF & R. WINTERS. *Engineering & Mining Journal,* Vol. 132, Apr. 1932, pages 197-200.

The new Pb plant of the United States Metals Refining Co. at Carteret, N. J., is an example of thoughtful design and careful planning to eliminate hazards formerly considered unavoidable. All furnaces discharge into an elaborate, balanced flue system. 4 separate ventilating systems are installed to reduce fumes: (1) for the reverberatory furnace and launder, (2) for softening furnaces and utility furnace, (3) for blast furnace, and (4) for retorts. Employes are under strict medical supervision and examination. WHB (31)

Reverberatory Smelting of Raw Concentrates at the International Smelter, Miami, Arizona. P. D. I. HONEYMAN (International Smelting Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 456, Feb. 1932, 11 pages.

Very fine flotation concentrates containing 11% water are being fed directly to the reverberatory. The costs for wet smelting on a reduced schedule compare favorably with the costs of prior practice at capacity production where the concentrates were dried, and the dust nuisance is practically eliminated. With a wet charge furnace wear is reduced, and the waste heat can be utilized. The changes in furnace charging and operation necessary for successful wet smelting are described. JLG (31)

Studies of Magnetic Sands. I. Factors Affecting the Rate of Reduction of Titaniferous Magnetic Sands. II. Effect of Silicious Matter on the Reduction of Magnetic Sand. III. On the Roasting of Magnetic Sand and Its Subsequent Reduction. KEIZO IWASE, MASAJI FUKUSIMA, MASAMI KOBAYASI & SHINROKU MITSUKURI. *Science Reports of the Tohoku Imperial University,* Japan, Vol. 20, Oct. 1931, pages 489-521, 522-535, 536-559.

Experiments carried out with 3 kinds of magnetic sands occurring in Japan have shown that they are much less reducible at temperatures between 800° and 1050° C. than hematite and magnetite. The grain size of the sand and the reducing agent have a great effect on the efficiency of the reduction. The content of TiO_2 in the sands varies from 0.5 to 42%. The test results are given in tables and diagrams. Part II. The presence of silicious matter generally retards the reduction rate of magnetic sands at 1000° C. or higher. When the sands contain reducible hematite excellent sintering occurs which is not the case with magnetite, which is reducible with difficulty up to 1050° C. By taking a longer period of time it is possible to reach 100% reduction even in the presence of silicious matter. Between 1000° and 1050° C., 100% reduction is reached in 2½ hrs. if the amount of silicious matter is made as small as possible. Part III. The sands were roasted at 700°-1100° C. in air and then reduced. It was more difficult to oxidize the sands completely to the ferric state than to deoxidize them completely to the metallic state because the roasting consists of only 1 stage of reaction, namely oxidation, while reduction consists of 2 stages of reaction taking place in succession, i.e. deoxidation and carburization. The size of the sand has a greater influence on the degree of oxidation than on the degree of reduction. In general, the poorer the reducing conditions the greater the advantage of roasting, but this may be modified by the temperature of reduction, nature of reducing agent and material to be reduced. Ha (31)

Blast Furnace Efficiency. S. P. KINNEY (H. A. Brassert Co.). *Blast Furnace & Steel Plant,* Vol. 19, Dec. 1931, pages 1562-1565.

Present practice is compared with that of 1924. Larger hearth diameter has been followed by an increase in the diameter of the stockline. The Venturi throat is a simple and efficient means of increasing stockline diameter and reducing dust losses. The Eichenberg process for reduction of flue dust has been widely adopted in Europe. This method consists of forming a rotating screen or curtain of gas and water at right angles to the upward flow of the gas. This screen is formed just above the stockline by using tangential jets of gas and water. Use of stockline recorders, showing movement of the stock column, enables the operator to correct conditions to obtain uniform furnace operation. Recently developed, electrically operated, automatic mud gun provides means of stopping the hole without taking off the blast, thus preventing undue settlement of the stock. Heat balances are presented for (1) 14 American furnaces operating on Mesabi practice in 1924 and (2) modern furnaces, practice being practically the same, except that whereas blast temperatures were formerly 1000°-1200° F., common practice now utilizes 1500°-1600° F., thus increasing the heat supplied to the furnace. This is accomplished by the use of fine cleaned gas on small checkered high-efficiency stoves employing the principle of uniform velocity and turbulent flow. Heat balance shows that of the total heat accounted for in the shaft, 89% may be accounted for now as compared with 81% in 1924, and that 53% is now used for reduction of the oxides as compared with 46% formerly. An increase of about 30% in the efficiency of boilers using blast furnace gas has been attained by better methods of heat transfer and the use of gas which has been previously cleaned. MS (31)

The Electrochemistry of Rhenium. A Few Reduction Products Originating at the Electrolysis of aqueous Potassium-Perrhenate-Solutions. (Beiträge zur Elektrochemie des Rheniums. Ueber einige Reduktionsprodukte, die bei der Elektrolyse von wässrigen Kaliumperrhenatelösungen entstehen.) H. HOELEMANN. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 202, Dec. 24, 1931, pages 277-291.

The methods for the reduction of ageous K-perrhenate solutions are reviewed and the qualitative phenomena of these electrolytic reductions described with and without the addition of H_2SO_4 or Na_2CO_3. The reduction products were investigated; the deposit on Pt cathodes contained oxide. Ha (31)

The Messina Stationary Basic Copper Converter. R. G. KNICKERBOCKER. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 458, Feb. 1932, 11 pages.

The smelting furnace at Messina, South Africa, produced a high-grade matte containing 60% Cu and practically no Au or Ag. The plant was constructed for production by the Nicholls-James process, but did not operate satisfactorily. Three furnaces had been built in cascade so that the molten matte or Cu could flow from one to the other. The second furnace was converted into a stationary converter. Tuyeres with oil-cooled steel pipe plugs were installed in this furnace. Details of construction of tuyeres and plugs are given. The matte was blown successfully to blister Cu in this furnace and refined in the third furnace. Cu meeting the A.S.T.M. specifications could be produced by this process, and the costs compared favorably with large scale production by other methods. JLG (31)

Flash-Combustion Roasting of Iron Pyrites. HORACE S. FREEMAN. *Transactions American Institute of Chemical Engineers,* Vol. 26, 1931, pages 148-157; *Chemical & Metallurgical Engineering,* Vol. 38, June 1931, pages 334-336.

From many mixed sulphide ores flotation has made available Fe pyrite ground to 200 mesh and even finer, containing 50% S and a minimum amount of gangue. When this product is roasted in the mechanical types of roasters at present in use it is found that, on account of the rapid roasting of the fine material and the greater amount of heat generated, the capacity of the roaster is considerably decreased and the wear and tear on brickwork and rabbles, and the cost of roasting are correspondingly increased. A special roaster was designed to overcome these difficulties. The engineering factors involved are discussed and the plant is described. The resultant product is interesting as a raw material for the production of sponge-Fe, to be directly smelted in electric furnaces. WHB (31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Relation of Coefficient of Expansion to Cross-Bending Strength of Sheet-Steel Enamels. MURRAY C. GAUTSCH. *Journal American Ceramic Society,* Vol. 15, Jan. 1932, pages 8-12.

2 series of enamels were made with calculated cubical coefficients of expansion from 361 to 306. In both series of enamels, the cross-bending values were inversely proportional to the coefficients of expansion. This is due to the fact that all enamels on sheet steel have lower coefficients of thermal expansion than steel. In cooling, after the enamel is fused to the metal, strains are set up in the enamel that lower the expansion of the enamel the greater the strains. When the enameled piece is bent, the greater the stresses present, the farther the piece can be bent before there is any real tensile strain on the enamel. High bending ability is dependent primarily on high compressive strains induced by lower coefficient of expansion of the enamel than the metal base. Compressive strains cause warping, fish-scaling (in ground coat), and chipping; therefore, the bending strength should not be too high. In all control work, both the minimum and the maximum bending strength should be specified. WAT (32)

Acid-Resisting, Dry-Process, Cast-Iron Enamels, and the Effects of BaO, PbO, and ZnO. L. D. FETTEROLF. *Journal American Ceramic Society,* Vol. 15, Jan. 1932, pages 1-7.

The following composition is suggested as one to which an acid-resisting enamel should agree in many respects:

	Per Cent		Per Cent
Na_2O	18	SiO_2	42
Ba_2O_3	5	Sb_2O_3	10
CaO	4	BaO	
CaF_2	1	PbO	14
TiO_2	6	ZnO	
			100

86% of the enamel composition must be held within these limits. This composition containing 14% ZnO or PbO, or any combination of these, smelts satisfactorily. Enamels containing 5% or more of BaO have poor smelting properties. Considering acid resistance, the amount of ZnO permissible depends upon the criterion used. The 7% citric acid test would permit up to 8% ZnO. The 7% HCl test would permit about 6% ZnO. The latter percentage agrees with the ZnO content of satisfactory enamels developed by Andrews. BaO and PbO are about equal and have no adverse effect on acid resistance. ZnO and PbO produce better gloss than BaO. Color and brightness may be improved by substitution of ZnO and (or) BaO, but preferably ZnO, for PbO. ZnO and BaO have about equal effects on fusibility. The fluxing effect of PbO is more pronounced. The proper combination of ZnO, BaO, and PbO must be determined by consideration of the acid resistance, fusibility, color and brightness requirements of an enamel. Each appears to contribute desirable properties. A desirable balance of these constituents in an enamel appears to be approximately 5% ZnO, 2% BaO, and 7% PbO. WAT (32)

Synthetic Resins Cut Finishing Time, Protect Longer. JOSEPH GESCHELIN. *Automotive Industries,* Vol. 65, Dec. 1931, pages 950-955, 958.

Author describes new resin surface with unique film-forming properties. This new surface can be introduced into present automobile body operations with reduction in baking period. Illustrations show (1) results of some representative hardness tests; (2) character of adherence and flexibility of film; (3) time process charts with 2 methods of finishing. The existing commercial synthetic resins are of 3 classes: (1) nitrocellulose lacquers, (2) varnishes, (3) condensation finishes of the air-dry and low-bake type; advantages of these finishes are enumerated. DTR (32)

Soil Action on Pipe Line Coatings. GORDON N. SCOTT (Bureau of Standards). *Gas Age-Record,* Vol. 65, Apr. 12, 1930, pages 510, 513-514.

Paper before the American Gas Association Distribution Conference, St. Louis, Apr. 1930. The action of the soil on protective coatings causing disruption of the coating, the so-called "soil-stress" effect, is described and explained. VVK (32)

Concrete Coverings for Pipe Lines. J. F. HOUGH (Portland Cement Association). *Oil & Gas Journal,* Vol. 29, Jan. 15, 1931, pages 62, 140-141.

As the result of testing some 2,000 concrete cylinders 10" in diameter and 24" long in sulphate soils and waters at Montrose, Colo., and Medicine Lake, S. D., the following coating and procedure was recommended for protecting pipe lines from soil corrosion. A mixture consisting of 1 part Portland cement, 1½ parts well-graded sand (0 to ¼") and 3 parts of gravel (¼" to ⅝") made with 4¾ gallons of water per sack of cement is poured into a sheet metal form around the pipe and shaken down with an electric vibrator. Reinforcement such as welded wire 2" x 6", No. 12 by No. 12, improved the strength of the coating. If reinforcement is not used, an asphalt emulsion is first applied to the pipe. The concrete covering should be at least 1" thick. Examples of pipe lines coated with concrete in extremely corrosive soils which have shown entirely satisfactory protection are given. VVK (32)

The Economics of Protective Coatings. LE ROY SLOAN (Southern Counties Gas Co.) & R. U. FITTING (Los Angeles Gas & Electric Corp.). *Gas Age-Record,* Vol. 66, Sept. 13, 1930, pages 405-406, 410.

Paper presented before the Pacific Coast Gas Association, Sept. 1930. Formulae and curves are given for estimating the allowable amount to be spent to justify a protective coating for a pipe line. VVK (32)

Synthetic Resins Provide Durable, Colorful Enamels for Metal Products. GEORGE S. HERRICK. *Iron Age,* Vol. 128, Dec. 10, 1931, pages 1482-1483, 1534.

The demand for colorful and durable finishes is broadening into new fields of metal consumption and the adoption of rustless steels has increased for colorful enamels on ordinary steel. Due to elasticity and toughness available in resins, enamel manufacturers are producing a variety of baked and air drying finishes. VSP (32)

Black Spots in Enamels. *Glashütte,* Vol. 61, 1931, pages 868-870.

Black spots in white enamels are usually caused by the presence of impurities or by chemical conversions of these impurities in the enamel. They may be produced by dust from the drying operation or during enameling, or by small particles of rust from the metallic frames used in the drying installations. The mills may also cause these spots and great care should be taken during their cleaning. The enamel should be fused in covered crucibles so that light ashes and soot will not fall into the melt. Chemical reasons for the black spots are: (1) They may appear if Sn oxide is used as opacifier when it contains large quantities of metallic Sn. Sn oxide should not contain more than 0.1% metallic Sn. (2) The enamel should be fired in a pure oxidizing flame, otherwise a reduction of Sn oxide to stannous oxide occurs producing the black spots. To avoid this reduction, the enamel batch should contain at least 6% saltpeter which counteracts the reduction in the melt and in the muffle. (3) Sb oxide being very easily reduced may cause black spots which also may be prevented by additions of saltpeter. (4) The black spots may be caused by the metal of the object and by the ground glaze. If the sheet metal contains accumulations of C and is not thoroughly pickled, this C promotes reduction. Small bubbles are formed which later collapse but leave in their place the black spots. If the coating of the ground enamel is irregular and covers the places containing C very thinly or not at all, C reacts more strongly. A ground enamel with good covering power and containing sufficient borax and bonding oxides should be used. WAT (32)

Formation of Wrinkles in Porcelain Enamel. *Glashütte,* Vol. 61, 1931, pages 832-833.

2 kinds of enamel should be used for enameling bathtubs because the vaulted edges of the tubes have greater tensions than the flat sides of the tubs. The enamel used for the edge should have a higher expansion than that used for the sides, a difference of 10 to 20 points depending upon the quality of the Fe. During enameling both enamels are mixed to a certain extent and a silky luster, which consists of very fine waves, appears in the place where the enamels were mixed. The explanation for this phenomenon is given. If the assumption that the formation of fine waves is due to the formation of a solid "skin" on the surface which wrinkles, then the size of the wrinkles depends on the size of contraction (shrinkage) of the enamel. In order to regulate the shrinkage, it is necessary to know the expansion of the enamel in the temperature field where it changes from the liquid to the solid state. The "crystallization" of the enamel is another important moment. Enamels oversaturated with opacifiers tend to crystallize and precipitate the opacifier at a definite temperature and a silky luster and mat enamel results. An enamel which is not oversaturated with opacifiers and whose coefficient of expansion at the critical temperature is known will shrink the least within the "skin" and therefore show the smallest waves. Microscopical researches show the exact reactions taking place between the 2 powder enamels. Both enamels endeavor mutually to decompose during firing which is impossible, owing to the short time at firing temperature. The greater the difference in the softening of the melting points between the edge and the interior powder, the more intensive is the reaction, and the more mat the enamel appears in this place. The melting points of both enamels should therefore be as close as possible because the greater this difference is, the more mat the enamel will be. WAT (32)

A. P. I. Pipe Coating Tests: Progress Reports to The American Petroleum Institute Committee on Corrosion of Oil Field Equipment. GORDON N. SCOTT (A. P. I. Research Associate, Bureau ofStandards). *Proceedings American Petroleum Institute,* Dec. 1931, Section IV, pages 53-107.

Progress Report No. 1—Installation of Test Coatings. The A. P. I. pipe coating test is a nationwide coöperative investigation of pipe protective coatings involving the pipe line interests, manufacturers of protective coatings, and the U. S Bureau of Standards. Tests are being made in 16 locations on 46 coatings applied to short lengths of pipe and on 19 coatings applied to working oil lines, 6" to 10" in diameter. The coatings are both mill-applied and field-applied. The test sites are distributed throughout the country, and represent a variety of soil and climate conditions. Complete details of installation are given. Progress Report No. II—Initial Inspection of Specimens. In addition to the visual examination of the specimens, two practicable tests for the field examination of protective coatings have been developed and described in detail. The conductance or resistivity of the coating was determined by first painting the coated pipe with flowing mud, wrapping with crepe paper and then applying a pad previously soaked in salt water, electrical contact then made with the pipe and the conductance determined by the voltmeter-ammeter method. After the conductance determination was made, a battery was connected, the pipe made the anode and current allowed to pass for from three to six minutes. The pad was then removed, the paper peeled off, immersed in 1% to 2% potassium ferricyanide made slightly acid with vinegar, washed and dried. This "pattern test" gave a record of the pinholes, flaws, etc. in the coating. The data to date indicates definitely that the effectiveness of the coating increases very rapidly with the thickness up to about 0.20". Comparatively thin asphalt and coal tar coatings were ineffective but the heavy coatings of both types were effective. Enamel coatings without shields or reinforcements reduce the anticipated average pitting by roughly 50% or less. All of the fabric-reinforced treatments, excepting a reinforced grease coating, reduce the anticipated average pitting by 80% or more. Shields are effective in general, but wood veneer is less effective than strip steel or pipe line felts. The problem of perfect protection is still largely one of minimizing the effect of soil stress. VVK (32)

Cement Lining of Used Cast Iron Pipe. J. R. TANNER. *Journal American Water Works Association,* Vol. 23, Apr. 1931, pages 521-528.

An account of the salvaging of a 16" water line; its cleaning and lining with cement. VVK (32)

ORE CONCENTRATION (33)

Refractoriness. H. A. White. *Journal of the Chemical Metallurgical, & Mining Society of South Africa,* Vol. 32, Dec. 1931, pages 97-101.
A mathematical measure of the refractoriness of an ore, especially the banket of the Witwatersrand, is developed.
AHE (33)

Development of Ore Dressing in Japan. Fukunosuke Yamada. *Proceedings World Engineering Congress,* Tokyo, 1929, Vol. 35, 1931, pages 411-443.
General. AHE (33)

Metallurgical Progress in South Africa. Andrew King. *South African Mining & Engineering Journal,* Vol. 42, Part II, Oct. 3, 1931, pages 109-110; Oct. 10, 1931, pages 133-134.
Presidential address before the C. M. & M. Society of South Africa. Waste rock from picking belts should not exceed 0.5 dwt./ton. 2 experiments showing extractions of 51% and 78% of the Au, respectively, are mentioned. Improvement in primary extraction attendant upon substitution of tube for ball mills is discussed. AHE (33)

The New Red, White and Blue Mine, Bendigo. A. F. S. Anderson. *Chemical Engineering & Mining Review,* Vol. 24, Jan. 5, 1932, page 125.
A brief description of the treatment plant. WHB (33)

The Daggafontein Reduction Plant. *South African Mining & Engineering Journal,* Vol. 42, Pt. II, Dec. 26, 1931, pages 421-422; Jan. 2, 1932, pages 443-444.
The flow sheet of the Daggafontein Au mill is described.
AHE (33)

The Relations Between Colloid Chemistry and Concentration. (Die Beziehungen zwischen Kolloidschemie und Aufbereitung.) W. Petersen (Bergakademie Freiberg). *Die Metallbörse,* Vol. 21, July 4, 1931, pages 1251-1252; July 11, 1931, pages 1299-1300; July 18, 1931, pages 1347-1348; July 25, 1931, page 1397.
Surface phenomena as the essential feature of the new concentration methods, colloid mills, dispersoid analysis, methods based on surface tension, flotation, oil sand dressing, electro-osmosis, kaolin elutriation, handling of waste water and differential sedimentation are discussed. EF (33)

Flotation (33c)

Use of Flotation in the Separation of Gold-Bearing Minerals. (El Empleo De La Flotation Para El Tratamiento De Las Minerales Auriferos). *Revista Minera,* Vol. 82, Dec. 1931, page 550.
Abstract of article originally published in *Anales de Minas de Rumania,* May and June, 1931. From the point of view of flotation, Au-bearing minerals may be classified as follows: (1) minerals that contain native Au with quartzose gangue; (2) those in which Au is combined with pyrite or other sulphates; (3) those that contain Au with appreciable amounts of As, Te, or Sb; (4) Cu, Pb, Zn, etc., minerals, in which Au is present as an impurity. These types of ore should be treated as follows: (1) flotation, followed by direct smelting of concentrates; (2) flotation, followed by amalgamation or cyanidation of concentrates; (3) amalgamation or cyanidation followed by flotation; (4) flotation followed by cyanidation of tailings. No flotation data are given.
DTR (33c)

Sodium Diethyldithiophosphate (Soda Aerofloat) as a Flotation Reagent. L. M. Becker. *Tzvetnuie Metallui,* Aug. 1931, pages 984-989.
American and Russian Na aerofloats gave unsatisfactory results in floating oxidized ores of Cu but gave very good results on sulphide ores. BND (33c)

Selective Flotation of Lead-Tin Oxide Ores in Mexico. (Auswählende Schwimmaufbereitung oxydischer Blei-Zinnerze in Mexiko.) C. Bruchhold. *Metal und Erz,* Vol. 28, Dec. 1931, pages 541-545.
In the Santa Eulalia plant of the American Smelting and Refining Co. in Chihuahua, Pb-Sn oxide ore is successfully concentrated by selective flotation. The very finely ground ore is treated with Na_2S and a concentrate of $PbCO_3$ is separated. The remaining Sn and Fe_3O_4 are smelted and separated electro-magnetically. The newest Fahrenwald flotation machine is described. CEM (33c)

Milling Methods and Costs at the Verde Central Concentrator, Jerome, Ariz. R. H. Dickson & E. M. Smith. *United States Bureau of Mines Information Circular* No. 6489, Sept. 1931, 12 pages.
The ore, which is composed of quartz, pyrite and chalcopyrite, averages Cu 2.7%, Ag 0.4 oz./ton and a negligible amount of Au. By flotation, recoveries of 93.3% of Cu are obtained in a concentrate assaying Cu 19.83%, Fe 28.9% and insoluble 16.1%. Tailings assay Cu 0.20%. Total costs are $1.192/ton of ore milled. AHE (33c)

Flotation. A. M. Gaudin. McGraw-Hill Book Co., New York, 1932. Cloth, 6 x 9½ inches, 552 pages. Price $6.00.
This book on flotation, the first in English since Taggart's in 1921, has been eagerly awaited by the metallurgists, chemists, college students, and business men for whom it was written. Great strides have been taken in the art since 1921, and few men in this country, or in the world, are as well qualified to describe and interpret them for us as Gaudin, whose work on the flotation of pure minerals has given him an international reputation. He outlines his book as follows: historical; fundamental chemistry; general technology; detailed technology and practice; economics. The development of the theory of flotation is especially clear, logical and complete, but perhaps does not indicate sufficiently the unstable character of many of the details of the theory, some of which are at present in controversy. Due to lack of space, crushing and grinding phases of the process are not considered, and little attention is devoted to mill design and flotation machinery; the historical and legal aspects also receive only brief treatment, owing, as Gaudin remarks, to signs of the patent tangle being cleared up. The book must inevitably be compared with the two recent German books on the subject, by Luyken and Bierbrauer and by Mayer and Schranz. Gaudin's exposition of the theory is more careful, and as his book is concerned chiefly with American practice, will be of more use to the American. It, like the other two, indicates the scope of modern flotation, which is now undertaking, experimentally and commercially, the concentration of a wide variety of sulphide and oxidized ores and non-metallic minerals.
John G. Attwood (33c)-B-

Flotation of Gold and Silver Ores. *Chemical Engineering & Mining Review,* Vol. 24, Feb. 5, 1932, pages 169-174.
From the standpoint of flotation, Au and Ag ores may be divided into 6 major groups: (1) ores containing native Au in quartz or quartz-adularia gangue; (2) ores with Au and Ag associated with oxides of Pb, Cu, and Fe; (3) ores with Au and Ag associated with pyrite or other sulphide; (4) ores with Au and Ag associated with As, Sb, or Te; (5) Co-Ni-As ores containing native Ag, and (6) ores with the Au and Ag associated with sulphide minerals of Cu, Pb, and Zn. General schemes utilizing flotation include: (1) straight flotation, followed by smelting of the concentrate, (2) flotation and amalgamation, (3) flotation followed by amalgamation and/ or cyanidation of the concentrate, and (4) flotation followed by cyanidation of the flotation tailings. Examples of these are cited. It is concluded that flotation is an accessory to cyanidation and that probably the combination of the 2 methods will extend the use of both, with flotation applied as a preliminary concentration treatment to raise the grade of the feed to the cyanide plant.
WHB (33c)

The Influence of Temperature on Flotation. (Ueber den Einfluss der Temperatur auf die Flotation.) Ion Huber-Panu. *Metall und Erz,* Vol. 28, Dec. 1931, pages 545-549.
The rate of flotation increased with rising temperature in every case studied. At 40° C. the time required was only ½ that at 6°. The foam going over in the first minute contained 50 to 100% more ore at the optimum temperature than at 6°. During succeeding minutes the ore content was lower with rising temperature. The total yield increases with rising temperature to a maximum and then drops off. Each ore has an optimum temperature, usually between 23° and 40°. The magnitude of the temperature effect depends on the flotation reagent, it is greater with xanthate and T-T mixture than with wood tar oil. In Cu ore the highest separation at 35° was 73% greater than the highest separation at 7°.
CEM (33c)

Pyrite Flotation at Aldermac, Quebec. W. G. Hubler (Aldermac Mines, Ltd.). *Canadian Mining & Metallurgical Bulletin* No. 239, Mar. 1932, pages 82-91.
Flotation reagents for the treatment of the old ore dump were: (1) Cu circuit: ball mill — lime 6-8, NaCN 0.01-0.05, thiocarbanalide 0.15 and xanthate 0.10; flotation pump sumps-pine oil 0.10; primary cells — $CuSO_4$ 0.15 lb.; (2) pyrite circuit: agitator cell — $CuSO_4$ 0.54, xanthate 0.25; cell 6 — xanthate 0.10 lb. When milling mine ore the reagents used were:—(1) Cu circuit: ball mill — soda ash 2.0, cyanide 0.04, thiocarbanalide 0.09; classifier overflow pump sump — pine oil 0.04; Cu roughers — pine oil 0.05, Na ethyl xanthate 0.05; (2) pyrite circuit: agitator cell — $CuSO_4$ 0.25, Na ethyl xanthate 0.17; cells 4, 6, 8, and 10 — xanthate, to each cell, 0.04; cell 6 — water gas tar 0.15 lb. The pyrite is suitable for flash roasting. AHE (33c)

Flotation Reagents, 1929. T. H. Miller & R. L. Kidd. *Report of Investigations* No. 3112, *United States Bureau of Mines,* Aug. 1931, 20 pages.
The total consumption of reagents in lbs./ton of ore treated in 1929 decreased over 4% from 1928. Trends: decreased consumption of frothing reagents, substitution of synthetic collectors for distillation collectors, more extensive use of butyl and amyl xanthates, introduction of aliphatic dithiophosphates and more extensive use of alkaline circuits. Pine oil, cresylic acid or o-toludine (frothers) was used in treating 98.44% of the ores floated. Consumption was 0.144 lb./ton of ore. Coal-tar creosotes, coal tars, wood-tar creosotes, pine-tar oils, petroleum products, blast-furnace oils, water-gas tars, ethyl xanthates (most important), butyl xanthates, amyl xanthates, dicresoldithiophosphoric acid, Na discresoldithiophosphates, Na diethyldithiophosphate, other dithiophosphates, benzyl mercaptan, thiocarbanilide and a-naphthalamine (all collectors) are used at the average rate of 0.126 lb./ton. H_2SO_4, 22.03 lbs./ton, and 3.735 lbs. of Na_2CO_3, NaOH, CaO (most important) or cement per ton are used to regulate the pH of the circuit. Na_2S is used for sulphidizing; $CuSO_4$ for activating; cyanides, Na_2SO_3, Na silicate, $ZnSO_4$ and Na_3PO_4 (average 0.213 lb./ton) for depressing; and $Al_2(SO_4)_3$, $CaCl_2$, NaCl, Na_2SO_4, S, turpentine and linseed oil for miscellaneous purposes. The use of each reagent on different ores is shown tabularly.
AHE (33c)

Magnetic Separation (33d)

Separation of Feebly Magnetic Ores. *Crushing & Grinding,* Vol. 1, Jan.-Feb. 1932, page 126.
A machine is described and results on the separation of wolframite from Sn are given. AHE (33d)

Magnetic Separators. *Crushing & Grinding,* Vol. 1, Jan.-Feb. 1932, pages 113-114.
General. AHE (33d)

The Iron Losses in Magnetic Separation. I. (Om järnförlusterna vid magnetisk separation.) Ernst Rothelius. *Jernkontorets Annaler,* Vol. 116, Jan. 1932, pages 1-19.
Studies have been carried out on the magnetite losses in 4 mills using both magnetic separation and concentrating tables. In mill A, in which 2 magnetic separators in series were adjusted to take a constant amperage of 6.5 and 5.6, the larger particles of magnetite were not taken out by the separators, and the smaller ones were washed away on the concentrating table. The magnetite losses are not given, but it is recommended that the ore be screened in two portions, one above 0.208 mm. and the other below, and these parts treated separately with the proper amperages and H_2O currents. Below 0.208 mm. the individual ore particles were cleanly broken. In mill B, 4 magnetic separators were used in series with 5 amp. at 104 volt and 35 r.p.m. The smallest particles were not adequately extracted, but were satisfactorily recovered by tabling. In mill C, 2 magnetic separators were used in series with 10.5 and 5 amps. at 110 volts and 35 r.p..m. In mill D, the same arrangement was used with 9.5 amp. at 104 volts and 43 r.p.m. The total recoveries of magnetite were, respectively, 86%, 88.2% and 94.3% on B, C, and D. Further laboratory studies are under way. HCD (33d)

MANUFACTURERS' LITERATURE REVIEWS

392 **Eraydo**—A pocket-size booklet prepared by the Illinois Zinc Co., Chicago, Ill., describes their new alloy, Eraydo. It is a zinc base alloy containing silver and copper. It is a tough metal, well adapted to deep drawing, extruding and forging. The booklet contains several chapters showing the many advantages of Eraydo in manufacturing operations. It is fully illustrated.

393 **Furnace Pressure Control**—Ryan, Scully & Co., Philadelphia, Pa., have prepared their Bulletin No. 1 in the form of a leaflet which describes their system of automatic pressure control in heat treating and heating operations.

394 **Industrial Compounds**—Technical Products Co., Pittsburgh, Pa., have issued Insa-Lute Cement & Compounds Catalog No. 32 which contains instructive information on industrial assembling, insulating, acid-proofing, etc. It gives many applications of their compounds for surface coating, furnace sealing, fireproof painting, electric insulation, repairing, etc.

395 **Cast Iron Pipe**—The United States Pipe and Foundry Co., Burlington, N. J., presents the new edition of the "Handbook of deLavaud Centrifugally Cast Iron Pipe." It gives the standard specifications for their cast iron pipe and tables showing the dimension and weights of the various classes.

396 **Table of Conversion Factors**—The Dorr Co., Inc., 247 Park Ave., New York, has prepared a table of conversion factors for engineers, a compendium of useful data for the rapid conversion of the common engineering units of measure of one system into the related units of another system.

397 **Cadmium Plating**—The Grasselli Chemical Co., Cleveland, Ohio, has sent out an attractive leaflet entitled "The Key to Lowest Possible Plating Costs" which describes the advantages of their Cadalyte process for electro-depositing pure metallic cadmium on iron and steel. With this process the plating time is said to be reduced and the equipment to cost less.

398 **Sand Core Binder**—General Plastics, Inc., North Tonawanda, N. Y., has prepared a leaflet telling about their Durez 476, a new and different binder for sand cores. It is used just as any oil is used and is recommended especially for cores of complicated design.

399 **Nickel Steel Topics**—The International Nickel Co., New York, N. Y., has issued Vol. 1, No. 1, of a new bi-monthly publication which contains technical, semi-technical and news articles dealing with the production, treatment and uses of nickel alloy steels.

400 **Magnetic Analysis**—Catalog No. 4 of the Magnetic Analysis Corp., 42 Twelfth St., Long Island City, N. Y., is a 20-page pamphlet which gives the theory of magnetic analysis, a description of the apparatus used and the properties of magnetic steel which have been determined with this equipment. Oscillograms are shown which were obtained in its application to strip steel, tool steel, butt welded tubing and the separation of steels of different chemical analysis.

401 **Corrosion-resisting Alloy Steels**—A 4-page bulletin giving physical and chemical data on these steels has been issued by the Duriron Co., Inc., Dayton, Ohio. A table of resistance to various chemicals for Durimet, KA2S and KA2SMo is included. There are also notes on machining, heat-treating and welding. This is bulletin No. 171.

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ALPHABETICAL INDEX TO ADVERTISERS

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402 **Electric Furnaces**—The Pittsburgh Electric Furnace Corp., Pittsburgh, Pa., has distributed a folder containing a description of one of the company's furnaces which is in operation at the Beach Foundry, Ltd., giving complete operating data and costs.

403 **Welded Construction**—Bulletin No. 2 of Lukenweld, Inc., Coatesville, Pa., contains many pictures showing the extending use of welded construction in the manufacture of steel plant and rolling mill equipment.

404 **Storage Batteries in Steel Mills**—The May issue of Exide News shows in illustrations the progress of iron from the ore to steel rails. The part storage batteries take in this process is briefly pointed out.

405 **Stress-Strain Recorder**—A folder prepared by the Baldwin-Southwark Corp., Philadelphia, Pa., describes their stress-strain recorder, tells how it works and gives typical graphs produced by this testing machine.

406 **Cadmium Plating**—The contributions of the Udylite Process Company to the cadmium plating industry are set forth in a pamphlet distributed by the company. The various services available to users of their process are enumerated.

407 **Wear of Metals**—The Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., is distributing copies of paper entitled "Relative Wear of Metals Due to Abrasion." It contains interesting data listing the Brinell Hardness and wear value of different materials as compared with a key steel.

408 **Grinding Tools**—Handbook and Catalog No. M 32 of the Carboloy Company, Inc., 2481 E. Grand Boulevard, Detroit, Mich., contains, in addition to the customary listing of their own tools, a section devoted to the manufacture, design, operation and maintenance of Carboloy tools and a section containing the listing of other tool manufacturers licensed to supply their tools equipped with Carboloy cemented carbide.

409 **Rustless Iron**—The Superior Steel Corporation, Pittsburgh, Pa., has compiled a pamphlet which gives the analysis and physical properties of their "Defirust," "Defistain" and "Defiheat" rustless iron. It includes a table showing the resistance of these irons to various media.

410 **Electric Furnaces**—Catalog No. 22 of the Ajax Metal Company, Philadelphia, illustrates their electric melting furnaces and gives specifications for them. One section of the catalog is devoted to a discussion of the principles of these furnaces and the advantages to be obtained in their use. This company is also distributing a reprint of an article entitled "The Development of the Electric Zinc Melting Process."

411 **Wrought Iron**—A most attractive booklet, "An Important Contribution to Metallurgy," prepared by the A. M. Byers Co., Pittsburgh, Pa., gives a pictorial review of the development of the large scale production of wrought iron and gives a detailed description of their new process. Another booklet issued by the same company is entitled "The Vital Element" and refers to the iron silicate, which, distributed throughout wrought iron, makes it so corrosion-resistant that wrought iron centuries old is still in excellent condition.

GENERAL (0)

Co-operative Research at Battelle Memorial Institute. *Metal Progress*, Vol. 20, Nov. 1931, pages 83-86.
The facilities of the Institute for conducting metallurgical research are described. WLC (0)

Co-operative Metallurgical Research—How? H. W. Gillett. *Metals & Alloys*, Vol. 2, Dec. 1931, pages 360-364.
The author describes the methods and scope of coöperative research being conducted by government bureaus, educational institutions and private enterprises in the field of metallurgy. WLC (0)

The Law of Patents for Chemists. Joseph Rossman. Inventors Publishing Co., Washington, 1932. Cloth, 6 x 8½ inches, 304 pages. Price $3.50.
The author is a Patent Office Examiner as well as Editor of the Journal of the Patent Office Society, and dates his book from the Patent Office. He frankly gives the purely defensive use of patents against pirates as an important reason for taking out patents. "Patent protection is absolutely essential to cover the products of a commercial laboratory, not so much for the return that comes from a patented article as from the fact that others may patent work which has already been done and thus involve expensive litigation." He suggests that courses in chemistry and chemical engineering should include one in patent law.
The scope of the book is similar to that of several others recently published relating to chemistry and metallurgy. It explains the principles of patent law, what types of discoveries are patentable, the steps in obtaining the patent, and the drawing of claims, etc. It is understandably written and gives specific examples to illustrate the generalizations. The discussion of "subtractive patents" is clearer than in most other books on the subject.
While it is written primarily for chemists, some of the examples given are metallurgical and the principles apply to metallurgical patents. The author admits that the Patent Office is not infallible, and that it can overlook publications or not know all the common practice in an industry, and may thus allow patents to be issued that are not valid. This inside view of the situation from the Patent Office point of view does not increase one's admiration for the patent system as a whole, if one has any such admiration, but it does help in explaining the rules of the game.
H. W. Gillett (0) -B-

Technology of Materials of Machine Construction. (Technologie der Maschinenbaustoffe.) Paul Schimpke. Sixth Edition, S. Hirzel Verlag, Leipzig, 1931. Paper 7 x 11 inches, 348 pages. Price 15 RM.
This textbook covers briefly but clearly the fundamentals of metallurgy from the engineering point of view. The production of the common metals and alloys, their properties, testing, casting, hot and cold working, joining by welding, etc. are described with sufficient illustrations of apparatus to show how most of the processes are carried out. German standard specifications are given for common metallic materials of construction.
Some of the sections are a bit sketchy, like that on electric steel, but in general, the volume would be a good text book for a technical school, and has value as a reference book.
H. W. Gillett (0) -B-

The National Physical Laboratory; Metallurgy Department. *Engineering*, Vol. 132, Aug. 21, 1931, pages 224-225.
Brief description of the investigations in progress at the present time. These include researches on light alloys, materials for use at high temperatures, cracking of boiler plates, gases in molten Fe and mild steel, and a systematic study of the constitution, structure and physical properties of binary alloys of Fe. LFM (0)

Journal of the Institute of Metals, Vol. 44, 1930, No. 2, 880 pages.
This volume gives 17 original papers in some 430 pages, abstracts and book reviews in some 335, and over 110 pages of index. The abstracts will hereafter be issued in separate volume at the end of the year, while the usual semi-annual volumes of original papers will continue to be issued. The original articles and abstracts are of the usual order of excellence. H. W. Gillett (0)-B-

Directory and Buyer's Guide. *The Engineer*, London, 1932. Paper, 5¼ x 8¼ inches, 260 pages. Free.
Technical headings for the materials covered in this are given in English, French, German, Italian and Spanish. This takes up 34 pages. The bulk of the pamphlet is devoted to names and addresses of British vendors, listed under the articles they supply. The last 9 pages list the British Standard Specifications, among which are many of metallurgical interest. H. W. Gillett (0) -B-

Recent Progress in Metallurgical Research. *Fuels & Furnaces*, Vol. 9, Nov. 1931, pages 1267-1268.
A condensed account of reports to the 5th annual meeting of the Metallurgical Advisory Board to the Carnegie Institute of Technology and the U. S. Bureau of Mines. Subjects of research include determination of oxygen and of nonmetallic inclusions in steel, corrosion of Cr-Ni-Fe alloys and their magnetic properties, and the Fe-Mn-C system with application of dilatometric and X-ray methods of study.
CMB (0)

Development of Metallurgy. (Zur Entwicklung der Metallkunde.) G. Tammann (University of Göttingen). *Die Naturwissenschaften*, Vol. 20, Jan. 1, 1932, pages 1-6.
The paper presented at the Gesellschaft der Wissenschaften, Göttingen, Nov. 1931, goes back as far as pre-historic times. With regard to the modern conceptions on metals, attention is focussed on the following problems: working and shaping properties, crystalline structure, properties studied on single crystals, physico-chemical and chemical phenomena due to cold working, effect of subsequent heat treatment on changes due to cold working, results of grain growth investigations, significance of the grain size with reference to physicals, influence exerted by a second alloying element, information furnished by constitutional diagrams, hardening of steel and Al, corrosion problems of Al, Mg, Fe, Cr. EF (0)

PROPERTIES OF METALS (1)

The Strength and Cleavage of Bismuth and Antimony Crystals. (Ueber die Zerreissfestigkeit von Wismuth- und Antimonkristallen.) G. Wassermann. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 18, 1931, pages 35-38; *Zeitschrift für Kristallographie*, Vol. 75, Nov. 1930, pages 369-378.
Single crystals of Bi and Sb were prepared by slow solidification of the molten metals in a glass tube. Twinning could be produced early in either Bi or Sb single crystals by little deformation. Cleavage in Bi usually occurs on the basic plane (0001). The crystals were broken in torsion and in normal stresses and the cleavage faces calculated. When cleavage occurred on the rhombohedral face, twinning was observed. The critical normal stress on this plane was found to be 680 g./mm². Mügges hypotheses with respect to twinning were confirmed. The determination of the normal stress across a plane at fracture allows a quantitative comparison of the cleavability. 10 references. JLG+Ha+WHB (1)

Relations between Hall Effect and Resistance. F. W. Warburton & J. W. Todd. *Physical Review*, Vol. 37, June 1931, page 775.
Thin gold films show the same relation between the electric resistance and the Hall effect as has been observed for Te for temperatures between room temperature and 100° C. The phenomenon is explained by conduction of electrons.
Ha (1)

Bismuth, Its Production and Utilization. (Das Wismuth, seine Gewinnung und Verwendung.) *Die Metallbörse*, Vol. 21, Nov. 21, 1931, pages 2025-2026; Dec. 5, 1931, pages 2089-2090; Dec. 16, 1931, page 2138.
The occurrence and sources of Bi and its metallurgical production are given. Attention is called to the latest process of Thum (German Patent 296,662), Charuau & Babau (French Patent 449,507), Norsk Hydro Elektrisk Kvaelstofaktieselskab (Norwegian Patents and French Patent 541,291). The extensive use of Bi in a large variety of commercial applications based on several of its unusual properties is reviewed. EF (1)

Resistivities of the Metals at 18° and the Problem of Their Relative Abundance in the Universe—Distribution of Radiant Energy from the Sun. F. H. Loring. *Chemical News & Journal of Industrial Science*, Vol. 142, June 19, 1931, pages 385-388; June 26, 1931, pages 403-407; Vol. 143, July 3, 1931, pages 4-7.
The resistivities of the metals appear to be approximately 10^{-6} times the "probability no." evolved from the atomic numbers of the inert gases by the equation $(2 \times (1^2 + 2^2 + 3^2 + 4^2 + 4^2) + n^2)/n$, when n is 1, 2, 3, 4, 3, 2, 1, successively. The most abundant elements also tend to follow the probability numbers in distribution about as well as could be expected. The probability numbers yield a curve that is very similar to the curve for intensity of solar radiation throughout the spectrum. WHB (1)

Investigations on the Becquerel Effect IV (Untersuchungen über den Becquerel Effekt IV). I. Liefschitz & R. Reggiani (University of Groningen). *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 155, Aug. 1931, pages 431-450.
The occurrence and possibility of measuring Becquerel effects of second Order on electrodes other than noble metal electrodes is discussed. The authors urge a more accurate method of investigating Becquerel effects of first order. Measurements were performed on Nb, Ta, Fe, Zn, Cd-valve anodes as well as on electrodes of other materials. The valve effect is considerably reduced or entirely eliminated by the radiation W, Mo and passive Fe do not exhibit any effect, which is probably completely lacking in the case of passive metals. W-bronze displays none; graphite and carborundum display typical effects. For all kinds of Becquerel effects, a decrease in the apparent cell resistance due to the exposure to light was the significant criterion. Simultaneously the e.m.f. changes. Conclusions with respect to the nature of the effect are drawn therefrom. EF (1)

Iron Soft as Copper. A. E. Buchanan. *Scientific American*, Vol. 146, Jan. 1932, page 42.
Highly purified Fe, possessing many of the qualities of Cu, has been prepared in Germany by a new process by Dr. L. Schlecht. Carbon monoxide of a high degree of purity is passed over hot Fe previously purified by ordinary methods, forming liquid iron carbonyl. On heating this liquid, carbon and oxygen are driven off, leaving iron in an exceedingly fine powdered form with hardly a trace of impurities. The individual spherical particles are estimated to be 20-millionths of an in. in diameter. When this powder is heated to a temperature of 1200° C., it is converted into solid Fe that resembles Cu in its softness, resistance to corrosion and other properties. The process is claimed to be applicable to large scale production. WAT (1)

Observations on the Pressure of Fluidity of Annealed Metals. Hugh O'Neill & Hubert Greenwood (The University, Manchester). *Institute of Metals, Advance Copy* No. 595, Apr. 1932, 21 pages.
The pressure of fluidity is that pressure at which a loaded punch continuously penetrates a block of ductile metal. Tests on blocks of metal subjected to the fluidity test showed that the most highly strained portions of the block had a Meyer's ball index No. $n = 2.0$, and a resistance to indentation equal to the pressure of fluidity. This latter value can therefore be determined from a ball test on metal cold rolled to the greater possible degree. The pressure required to extrude a metal through a die is roughly equal to the pressure of fluidity or to 2 times the Brinell hardness number of the annealed material. The tensile test is analyzed, and it is concluded that the true stress plotted against the relative reduction in diameter is a straight line above the maximum load, as found by Stead. A correlation between tensile, compressive, indentation and punching tests is suggested. Tests on annealed wires drawn to 20% reduction in 1 pass indicated that the maximum stress required for drawing under such conditions was much lower than the pressure of fluidity. 23 references. JLG (1)

Thickness of Standard Copper Sheets—Rolled to Weight. J. K. Olsen. *Metal Stampings*, Vol. 4, May 1931, page 442.
This table gives the thickness in decimal parts of an in. of rolled Cu sheet weighing from 20 lbs./ft.² to 1 oz./ft.². One ft.³ of Cu weighs 555.56 lbs. JN (1)

Outlook for Zinc. A. P. Cobb (New Jersey Zinc Co.). *Mining Congress Journal*, Vol. 17, Nov. 1931, pages 594-596.

In all times a large part of the annual production of metallic Zn is used in galvanizing or "zinc-coating." There is more use for prime Western slab Zn, often called "common metal." American Zinc Institute is studying advantages of more heavily zinc-coated sheets. Special zinc-coating jobs require high grade Zn, such as Horse-head & Horse-head Special. Today, Zn is being used in large scale electrification of railroad lines, for signal cable wrapping, in radios, for eyelets, grommets, shoelace tips and other stable items. The use of rolled Zn for automobile running-board molding is increasing. The plating of rolled Zn and Zn die-castings is an important matter for an extension of markets; almost any type of finish may be applied and any kind of electroplated coating. Refrigerator hardware is attracting the white metal. Zn for die castings is gradually passing away from the biggest obstacle to its use in the past—prejudices due to unfortunate experiences. Horse-head Special 99.99+% is used. New Zn alloys are being perfected for service in fields where present alloys have not all the qualities required. In the paint industry, Lithopone (28-30% ZnS) is the most commonly used white paint pigment. The perfectly prepared Lithopone paints, ZnS and ZnO, are naturally and permanently white and slow chalking of Zn pigment paints means economy together with no change in the color during the life of the paint. Lithopone paints have more covering power than any other type of paint. There is also the high ZnS pigment field, cryptones. Consumption is smaller than that of Lithopone, but cryptones contain nearly twice as much ZnS. ZnO is a fixture in paint technology due to extra-durability to all paint films, washability to wall paints and slower chalking to outside house paints. Zn dust pigment has come to the fore, especially since ZnO has been mixed with it to reduce the high specific gravity. It is more efficient as a corrosion-resistant agent than any other standard metal priming paint. A special characteristic of Zn dust (ZnO) paint when used on black iron or steel is the tenacity with which the priming coat adheres to the metal. DTR (1)

Relation of Rolled-Texture, Deep Drawing Properties and Hardness of Ag, Cu, Al, and an Ag-Cu alloy. (Experimentelle Studien über den Zusammenhang zwischen Walztexture, Tiefziehfähigkeit und Härte bei den Metallen Ag, Cu, Al und einer Ag-Cu Legierung). H. Holzmann. *Siebert Festschrift*, 1931, pages 121-148.

The Ag-Cu alloy contained 83.5% Ag, 16.5% Cu. Above 40% reduction in rolling, the Brinell hardness of material rolled in one direction only is higher than on material cross rolled, for Cu, Al and the Ag-Cu alloy, while for Ag it is higher at all reductions. The Erichsen value of the Ag-Cu alloy falls off very rapidly at reductions of 60% and over, while, if the sheet is turned 90° at each 1/10 mm. reduction in thickness, the Erichsen value is as good at 98% reduction as at 50%. With no cross rolling, the Erichsen value for Ag reaches a minimum at 85% reduction, for Cu at 90% and for Al at 65%, and then improves slightly. Material annealed after rolling without and with cross rolling was also subjected to the Erichsen test. It made no difference on Ag whether or not the reduction had been by cross rolling, but above 80% reduction on Cu, 95% on Al and 80% on the Ag-Cu alloy, the depth of cup was less on material rolled in one direction only, while cross-rolled material showed no injury. The angle of nip in rolling was varied from 90° to 45° and 22½° without altering the results. HWG (1)

Metal Contacts with Films. (Vorläufige Mitteilung über Metallkontakte mit sehr dünner Fremdschicht.) R. Holm. *Zeitschrift für technische Physik*, Vol. 4, Dec. 1931, pages 663-665.

Films are rapidly formed on base metal surfaces in air. Although they destroy metallic adhesion, the films actually do not materially affect the electrical resistance of the contacts at ordinary temperatures, the conductivity being of a peculiar type. With falling temperature the conductivity does not change essentially until supraconductivity occurs as is the case with Sn. EF (1)

Mercury for Dental Amalgams. Aaron Isaacs. *Journal American Dental Association*, Vol. 19, Jan. 1932, pages 54-57.

The purpose of the investigation was to compare the quality of various grades and brands of Hg available to the dental profession and to develop a specification for Hg satisfactory for use in dental amalgams. To Hg which had been carefully purified 0.001% of Cu, Zn, Sn, Pb, Bi, Cd, As, Sb, Ag and Au were added as impurities. The As was only partly, if at all, dissolved. The presence of any of these metals except Ag and Au was readily detected by the film or "skin" formed on the surface of the mercury. The Ag and Au were detected as non-volatile residues. Of 5 commercial samples of U. S. P. Hg all were free from non-volatile residues. Of 8 samples of Hg graded as "Dental C. P." only 4 showed non-volatile residues, which were Ag in every case and not harmful for use in dental amalgams. Glass containers were found to be better than wood or stoneware. A mirror surface on the mercury indicates the absence of the base metals, and specification No. 6 of the American Dental Association permits not more than .02% of non-volatile residue. Clean, clear glass containers are required. OEH (1)

Festival Volume for the 50th Anniversary of the Siebert Platinum Works. (Festschrift zum fünfzigjährigen bestehen der Platinschmelze G. Siebert, G. m.b.H. Hanau.) Edited by H. Houben. G. M. Alberti's Hofbuchhandlung, Hanau, 1931. Cloth, 6½ x 9½ inches, 338 pages. Price 10 RM.

Following a brief history of the Siebert organization and list of its products, there are given 20 articles on precious metals by 28 authors and collaborators. Five of the articles are on purely chemical subjects, the balance are metallurgical and of importance to those interested in the rare metals. Especially important are the articles on thermocouples, effect of other elements on the Au-Pt system, effect of oxides on Pt at high temperatures, and on X-ray studies of Ag Pd, Au Pd and Au Pt.

The metallurgical articles are separately abstracted.

H. W. Gillett (1) -B-

The Contribution of Protons to the Electric Conductivity of Metals. (Ueber die Beteiligung von Protonen an der Elektrizitätsleitung in Metallen.) D. P. Smith. *Zeitschrift für Physik*, Vol. 69, May 1st, 1931, pages 253-258.

On the basis of observations on Pd charged with hydrogen the part of the protons in the conductivity is discussed. It seems that the conductivity does not only depend on the existing protons but also on other slow electrolytic transformations. Ha (1)

Electrical and Mechanical Effects on Metallic Wires by Thermal, Magnetic or Acoustic Influences on the Structure. (Elektrische und mechanische Effekte an Metalldrähten bei thermischer, magnetischer oder akustischer Beeinflussung der Struktur.) A. V. Hippel & O. Stierstadt. *Zeitschrift für Physik*, Vol. 69, Apr. 23, 1931, pages 52-55.

If a lattice element passes from one well defined energetic state into another a sudden dislocation of the electric charge must take place and consequently a dislocation current should be observed in a suitable device. This was proved to be true by leading the amplified current to a loud-speaker. Heating of an iron wire, magnetizing, cooling below the Curie point in a magnetic field, and pulling extended wires produced sounds in the loud-speaker. Ha (1)

Note on the Coefficient of Thermal Expansion of Gallium and the Products $a \times T_s$ of the Elements. (Notiz über den Ausdehnungskoefficienten des Galliums und das Produkt $a \times T_s$ bei Elementen.) Wilhelm Klemm. *Zeitschrift für anorganische und allegemeine Chemie*, Vol. 198, May 28, 1931, pages 178-183.

(1) The cubic coefficient of thermal expansion between 18° and — 78.3° C. of Ga (containing In 0.16, Zn 0.10, Pb 0.10%) is 5.3 (± 0.5) × 10^{-5} and its density at 25° C., 5.913. (2) Curves are given and discussed showing the values of $1/T_s$, $a \times 10^{-5}$, and $a \times T_s$ of the elements against the atomic number, a and T_s being the coefficient of thermal expansion at room temperature and the melting point in degrees absolute respectively. WHB (1)

Study of the Bending Elasticity of Iron, Copper, Gold, Silver, Platinum, Fused Silica, and Nickel. (Etude sur l'elasticite de flexion Fer- Cuivre- Or- Argent- Platine Verre de silice- Nickel.) A. Jacquerod & H. Mügeli. *Helvetica Physica Acta*, Vol. 4, Feb. 16, 1931, pages 3-30.

Young's moduli of the metals were determined from the time of swing of a torsion pendulum to which spiral springs of the metals were attached. The results obtained were as follows:

Metal	State	E at 0° C. Kg./mm.²	Temperature Coefficient 0°-100° C. × 10^{-4}
Copper	drawn	12,870	3.986
Gold	annealed	8,060	3.988
Silver	"	9,300	5.715
Platinum	"	19,900	0.75
	drawn	22,100	3.108
Nickel	annealed	20,400	10.56

The precious metals were annealed for 100-120 hrs. at 142°-145° C. and the Ni for 10 hrs. at 585° C. The values for Ag altered appreciably over a long period. WHB (1)

Revision of the Atomic Weight of Calcium. Atomic Weight of Calcium from Sylvite. (Revision des Atomgewichtes des Calciums Atomgewicht des Calciums aus Sylvin.) O. Hönigschmid & Käte Kempter. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 195, Jan. 7, 1931, pages 1-14.

The atomic weight of Ca was found to be 40.085 ± 0.00060, i. e. a little higher than the mean value of all determinations by Richards and by Hönigschmid since 1903 (40.078). The atomic weight of Ca prepared from sylvite was found to be 40.091 after taking into consideration the possibility of the presence of traces of Sr. WHB (1)

Some Photoelectric and Thermionic Properties of Rhodium. E. H. Dixon. *Physical Review*, Vol. 37, Jan. 1931, pages 60-69.

The photoelectric current of a thin strip of Rh increases 130% from 25° to 950° C.; at 240° C. a sudden increase took place. Another anomaly was found at 1100° C. where the photoelectric current became irregular and the resistance temperature coefficient changed. Ha (1)

The Half-Value Period of Uranium. O. Gratias & C. H. Collie. *Proceedings Royal Society*, Vol. 135A, Mar. 1932, pages 299-306.

The half-value period of uranium has been redetermined; the ionisation current was measured by an electrometer, and a null method in which the current from the uranium was balanced by that from a variable polonium source. These gave as a mean of 5 concordant determinations $\lambda = 8.02 \times 10^{-6}$ sec.$^{-1}$ corresponding to a half-value period of 24.0 ± 0.58 hours. WAT (1)

The Boiling of Some Metals and Alloys at Atmospheric Pressure. (Ueber das Sieden einiger Metalle und Legierungen bei Atmosphärendruck.) W. Leitgebel. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 202, Dec. 24, 1931, pages 305-324.

The tests were made in a high-frequency furnace where the metal was in motion during the measurements; the newly made determinations of boiling points were:

Cadmium	767° ± 2° C.	Bismuth	1560° ± 5° C.
Zinc	907° ± 2° C.	Antimony	1635° ± 8° C.
Magnesium	1097° ± 3° C.	Lead	1740° ± 10° C.
Thallium	1457° ± 10° C.		

Boiling curves of the following systems were investigated: Al-Mg, Al-Zn, Bi-Pb, Bi-Sb, Cd-Pb, Cd-Mg, Cd-Zn, Cu-Zn, Mg-Pb, Mg-Sb, Mg-Zn, Pb-Sb, Pb-Te, Pb-Zn, Sb-Zn. A maximum in the boiling curve was found for Bi-Sb and Pb-Sb. The increase in the boiling point of binary systems was the greater the smaller the atomic weight of the added metal. The ternary system Cd-Pb-Zn was also investigated, the boiling point of Cd increases fairly uniformly up to the boiling point of the system Pb-Zn. 90 references. Ha (1)

The Development of Research on Rhenium since 1925. (Die Entwicklung der Rheniumforschung seit 1925.) W. Noddack. *Die Metallbörse*, Vol. 21, July 22, 1931, page 1374.

The rapid historical development of rhenium since its discovery is reviewed at the General Meeting of the Verein Deutscher Chemiker, Vienna, 1931. EF (1)

Platinum. Donald McDonald. *Canadian Chemistry & Metallurgy*, Vol. 16, Feb. 1932, pages 28-30.

An abstract dealing with the purification and metallurgy, physical and chemical properties, uses and economics of Pt. WHB (1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

Modern Die Casting of Aluminum. G. M. Rollason (U. S. Aluminum Co.) & Sam Tour (Lucius Pitkin, Inc.). *Metal Progress,* Vol. 21, Jan. 1932, pages 32-37.

Gives summary of advantages, limitation and applications of Al die castings. Discusses briefly the effects of small amounts of Cu, Fe, Zn, Si, Sn, Mn and Cr on the alloy. A table shows the physical properties and compositions of typical alloys. Machining, polishing, plating and dipping of castings are discussed. WLC (2)

Nickel in Aluminum Brass. W. B. Price. *Metals & Alloys,* Vol. 2, Dec. 1931, page 366.

Abstract by H. W. Gillett showing compositions and properties of these alloys. WLC (2)

Zinc Die Castings. W. M. Peirce (N. J. Zinc Co.) & Marc Stern (AC Spark Plug Co.). *Metal Progress,* Vol. 20, Dec. 1931, pages 53-58.

Application of Al:Cu:Mg, 4:3:0.1% Zn base die castings to a wide range of parts are described: typewriter frames, radio chassis, electric fan housings and clock cases. Composition as to impurities is held to less than 0.02% with Al 3.5/4.5%, Cu 2.5/3.5% and Mg 0.02/0.12%. Effects of aging on the properties are tabulated. Material has an average tensile strength of 44,000 lbs./in.^{2} with average elongation of 2.0%. Other physical properties, density, melting point, hardness, thermal expansion, thermal and electrical conductivity are given. Machining characteristics are discussed with recommended clearance angles. The electroplating of Zn die casting is briefly discussed. WLC (2)

Plasticity of Copper-Zinc Alloys. Alan Morris. *Metal Stampings,* Vol. 4, Apr. 1931, page 320.

Abstract of a paper presented at the New York meeting of The American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys,* Vol. 2, June 1931, page 112. JN (2)

Antifriction Alloys with Magnesium Base. A. M. Bochvar & F. A. Luneff. *Tsvetnui Metallui,* Sept. 1931, pages 1135-1139.

Mg-Si, Mg-Ca, and Mg-Si-Ca alloys were studied. It was found that of the 3 systems only Mg-Si alloys can be used as antifriction light weight alloys. The alloys with from 1.68 to 3.21% Si possess a suitable structure, melting point of 650° to 700° C. depending on the Si content, and Brinell hardness from 30 to 40 (Shore 12 to 16). BND (2)

Alloys of Platinum with Iridium. (Legierungen des Platins mit Iridium.) W. A. Nemilow. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 204, Feb. 9, 1932, pages 41-48.

The Pt was investigated with 0 to 100% additions of Ir. The Brinell hardness shows at 50% a maximum of 256.4 kg./mm^2. The drawing of wires with more than 20% Ir is very difficult, the tearing strength of the 20% alloy was 61.3 kg./mm. The microstructure of all alloys shows solid solutions; annealing changes the structure only slightly. The specific electric resistance increases with the increase of Ir which proves the presence of a solid solution. The temperature coefficient shows a minimum at about 45% Ir. All test results are reproduced in detail; 12 references. Ha (2)

Aluminum-Brasses. (Ueber Aluminium-Messinge.) B. Blumenthal. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Jan. 9, 1932, page 43.

The Al-brasses have a greater strength and elongation than ordinary brass if the thin oxide film formed by molten Al does not get into the block. The oxide film prevents the evaporation of Zn; an addition of 0.1% being sufficient. Albrass is very suitable for condenser tubes, particularly the composition of 76% Cu, 22% Zn, 2% Al; this alloy is very resistant to corrosion. Ha (2)

Note on Bearing Metals with a Pb-Sn Base (Beiträge zur Kenntnis der Lagermetalle auf Blei-Zinn-Basis). A. Demmer. Doctor's thesis, University of Bonn, 1931, 45 pages.

The data are tabulated from which were drawn the compression curves and the elevated temperature hardness curves for Pb-Sn-Sb alloys with and without Ni, Mg, P, or Cu, in the report by E. Hertel and A. Demmer, *Metallwirtschrift,* Vol. 10, February 13, 1931, pages 125-126. See *Metals & Alloys,* Vol. 2, July 1931, page 126. HWG (2)

Nickel-Copper Alloys of High Elastic Limit. Jones, Pfeil & Griffiths. *Engineer,* Vol. 152, Sept. 25, 1931, page 331.

Abstract of paper read before the Institute of Metals, Zurich, Switzerland, Sept. 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 297. LFM (2)

Everdur Metal—A High Strength, Corrosion Resistant Engineering Material. C. B. Jacobs, Jr. *Metals & Alloys,* Vol. 3, Jan. 1932, page 26.

The physical properties comparable to steel, of a Cu alloy of 4¼% Si and 1.2% Mn are described. The alloy is very easily worked and exhibits excellent corrosion resistance for a variety of applications. WLC (2)

Aluminum Alloys Used in the Foundry. (Les alliages d'aluminium utilisés en fonderie.) Jacques Douchement. *Revue de Métallurgie,* Vol. 28, Oct. 1931, pages 557-564.

A review of the properties of Al alloys as applied to castings for the aviation industry. Among them is described a French alloy, Eutectal (1.5 Cu, 0.8 Mn, 0.35 Ti, 1.58 Mg_2Si), which, after soaking for 6 hrs. at 525° C., quenching and drawing for 9 hrs. at 150° C., has an elastic limit of 23.5 kg./mm.^{2}, tensile strength 27.7 kg./mm.^{2} and Brinell hardness 98. JDG (2)

Studies in Lead-Alloys. (Studien über Bleilegierungen.) B. Garre & A. Mueller. *Zeitschrift anorganische und allgemeine Chemie,* Vol. 198, June 10, 1931, pages 297-309.

A considerable increase of hardness was observed in Pb-Cd-Sb alloys after quenching and aging. A general temperature-concentration diagram between Pb and CdSb was determined and the hardness measured under various conditions; cold-working is not necessary for hardening. At definite ratios of additions of Cd and Sb quenching is not necessary, hardening takes place after normal cooling. Additions of Sn and Zn do not promote hardening. The property of commercial Pb to become brittle below the melting point is due to the melting of eutectics. Pb of coarse grain is brittle under certain conditions; breaking without noticeable deformation. A number of aging and equilibrium diagrams are reproduced. Ha (2)

Magnesium Alloys. Correspondence from F. Giolitti, Turin, Italy. *Metal Progress,* Vol. 21, Jan. 1932, pages 68-69.

Notes on the recent industrial exhibit at Milan and the increased interest in light magnesium alloys evident among Italian manufacturers. WLC (2)

Preparation and Some Physical Properties of Sr-Cd Alloys. H. C. Hodge, *et al.* (College of the Pacific, Stockton, Calif.). *Metals & Alloys,* Vol. 2, Dec. 1931, pages 355-357.

8 references. Sr-Cd alloys were prepared by electrolysis of eutectic mixture of $SrCl_2$ and NaCl over a bath of molten Cd in a suitably wired crucible. The Cd served as cathode and a carbon rod as anode. Thermal analyses of alloys up to 26% Sr are reported. Micrographs show the structures observed in cast and annealed conditions. Curves show the effect of Sr in increasing the hardness and specific gravity of the alloys. WLC (2)

Melting and Casting of Aluminium Bronzes. Edmund R. Thews. *Metallurgist,* Oct. 1931, pages 159-160.

The Cu-Al alloys employed for artistic and chemical purposes as well as in marine engineering usually contain, besides Cu, about 8 to 12% Al and smaller percentages of Fe or Ni (1 to 4%). Fe, Mn, Ni, and, to some extent, Si may be considered desirable constituents if present in suitable proportions, while As, P, and Sb are distinctly harmful. Virgin metals only should be used. 0.3%-1.00% Mn tend to improve the resistance to atmospheric corrosion and sea water as well as the tensile strength, without lowering the ductility of Al bronze castings. Larger percentages result in very appreciable deterioration of the casting properties. The addition of Ni improves the density and the corrosion resistance of the castings to sea water. Small percentages of Zn serve to counteract the tendency of straight Al bronzes to form coarsely crystalline structures, but exert a distinctly deteriorating influence on their mechanical properties and, since the only advantage of Zn is also shared by Fe—in percentages above 4—, the alloys of this group should preferably be maintained from Zn. The addition of from 1.0 to 1.5% Pb improves the cutting qualities of the castings without appreciably deteriorating their chemical and mechanical properties and their structure. Straight Al bronzes are produced by first melting down and deoxidizing the Cu, then adding the required quantities of Al in the form of a 50/50 hardener. It is absolutely necessary before adding the Al thoroughly to deoxidize the Cu by means of phosphor copper. The methods used for producing the hardener are: (1) adding solid Al to fused Cu; (2) adding fused Al to liquid Cu; (3) adding liquid Cu to fused Al, (4) adding solid Cu to fused Al. Method (4) is generally used in the United States and (3) in Continental countries. These are described in detail. Detailed directions given for pouring Al bronzes. (2)

An Investigation of Duralumin Wire. I. G. Shoulgin. *Transactions of the Central Aero-Hydrodynamical Institute,* No. 83, May 1931, 44 pages, 40 illustrations. (In Russian).

Physical properties of duralumin wire of different diameters and subjected to different heat treatments were investigated. General observations regarding the temperature effect are given. (2)

Cast Gold Alloys: Their Physical Properties and Dental Application. J. S. Shell. *Journal American Dental Association,* Vol. 18, May 1931, pages 904-916.

Hardness, tensile strength, elongation, elasticity, endurance strength, and the relation of these properties of cast Au alloys to their application in dental work is discussed. A refining is possible by partial transformation of the solid solutions into the intermetallic compound AuCu. Alloys of 70% Au, 5% Pt, 15% Cu, and the remainder of Ag, Pd, Zn increase their strength from 46 to 70 kg./mm.^{2} by heating at from 250-425° C. Ha (2)

Lead-base and Tin-base Alloys for Die Castings. F. J. Tobias. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 1, 1931, pages 280-283.

See abstract of preprint. *Metals & Alloys,* Vol. 2, Nov. 1931, page 243. HWG (2)

Aluminium, Its Alloys and Some Applications. *Metallurgia,* Vol. 5, Apr. 1932, pages 203-206.

A review. Mentions ores, production of Al, use and properties of Al and its alloys. JLG (2)

Copper-beryllium "Bronzes." J. Kent Smith (Beryllium Development Corp.) *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 465, Feb. 1932, 14 pages.

Bibliography of 11 references. Describes a series of experiments in which Be-Cu alloys containing as much as 2.75% Be were tested in the wrought condition. Both hardness and tensile tests showed that alloys containing over 1.5% Be could be hardened by quenching and aging .The strength and hardness of the age-hardened alloys could be materially increased by cold work. Tensile strengths as high as 220,000 lb./in.^{2} resulted from age hardening and then rolling a 1.91% Be alloy. The alloys were made from a 12-15% Be master alloy, which is now commercially available. JLG (2)

Copper-Titanium Alloys. *Metallurgist,* Oct. 1931, pages 157-158.

An extended abstract of *Technical Publication* No. 432, *American Institute of Mining and Metallurgical Engineers* by F. R. Hensel and E. I. Larsen. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 298. VVK (2)

Technology and Utilization of Electron Metal. (Technologie und Anwendung des Elektronmetalls.) W. Schmidt. *Die Metallbörse,* Vol. 21, June 27, 1931, page 1206.

Composition, physical properties, corrosion resistance, refining processes, casting, hot working and shaping, utilization in aviation and automobile industry are considered in a paper before the Deutsche Bunsengesellschaft für angewandte physikalische Chemie, 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 2. EF (2)

A New Aluminium Alloy. *Electrical Times,* Vol. 81, Jan. 7, 1932, page 23; *Metal Industry,* London, Vol. 40, Jan. 1, 1932, page 14.

The new alloy MG7, produced by James Booth & Co., Ltd., is composed of Al, Mg and Mn. Its specific gravity is 2.36, the mechanical properties are similar to "Duralumin." It is not capable of heat treatment, but application of cold work hardens quickly. The resistance to corrosion particularly that of sea water is extremely high. Effect of same corroding medium within 100 days: MG7 25.1; Duralumin 19.5; Soft Al. 5.06 in max. stress-tons/in. WR (2)

PROPERTIES OF FERROUS ALLOYS (3)

Some Physical Properties of Hardened Tool Steel. J. V. Emmons. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 47-82.

Includes discussion. See abstract of preprint, *Metals & Alloys,* Vol. 2, Oct. 1931, page 205. HWG (3)

Single Potentials of Iron and Steel Electrodes. Kikozo Endo & Shigenori Kanazawa. *Science Reports Tohoku Imperial University,* Vol. 20, Mar. 1931, pages 124-139.

The effect on the electrode potential of grain boundary and also that of slight strain in the electrode were studied. See *Metals & Alloys,* Vol. 1, Dec. 1930, page 900. (3)

Progress in Rustless Steels. L. Sanderson. *Steam Engineer,* Vol. 1, No. 5, Feb. 1932, pages 213-214.

A review of the present development of stainless and heat-resisting steels. AHE (3)

The Precipitation Hardening of Iron by Titanium. (Ueber die Ausscheidehärtung des Eisens durch Titan.) *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Nov. 14, 1931, page 1418.

See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 31. Ha (3)

Improving Service of Steel Castings to Industry. *Steel,* Vol. 88, Feb. 26, 1931, pages 41, 43, 53.

As a result of improved manufacturing methods, better metallurgical control, and closer attention to markets and to service requirements, the steel foundry is now in a strong competitive position. Better control of melting operations, more exacting supervision, and closer inspection have resulted in the universal production of stronger castings. A representative air-quenched and drawn cast steel has a tensile strength of 70,000 to 80,000 lbs./in.^{2}, a yield point of 40,000 to 50,000 lbs., an elongation of 22 to 30%, and a reduction in area of 30 to 50%. The physical properties of cast steel are discussed at some length. The new foundry and new heat treating unit of the Lebanon Steel Foundry, Lebanon, Pa., are described. JN (3)

The Practical Application of New Formulae for Determining the Quality of Cast Iron. *Foundry Trade Journal,* Vol. 45, Oct. 29, 1931, pages 265-266.

An extended abstract of an article by H. Pinsl, which appeared in *Die Giesserei* (Vol. 18, 1931, pages 334-339, 357-363). See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 31. OWE (3)

The Changes of Electric Conductivity of Ferromagnetic Materials in Magnetic Fields. (Die Aenderungen der Elektrischen Leitfähigkeit Ferromagnetischer Stoffe in Magnetfeldern.) O. Stierstadt. *Zeitschrift für technische Physik,* Vol. 13, No. 2, 1932, pages 65-71.

The apparatus and methods used in the tests and the theory of the measuring methods are explained and a few hysteresis curves in magnetic fields for several materials are reproduced. The author shows that the exterior magnetic field does not define the physical condition of a ferromagnetic material, but the interior field, the magnetic induction or the magnetization. For a theoretical explanation the magnetization curve B=f(h) must be plotted together with the change of resistance and the changes be represented as function of the inner field B. The virginal magnetization curve can then be expressed very closely by $dw/w=c\times B^x$; the exponent x for Fe and Ni lies between 3 and 4, the constant c is of the order 10^{-15} to 10^{-20}. Ha (3)

Fabricating Stainless Steel. C. C. Snyder (Republic Steel Co.). *Machinery,* Vol. 38, Nov. 1931, page 173.

Abstract of a paper before the Indiana section of the Society of Automotive Engineers. Steel known as 18-8 or Krupp Nirosta KA-2 has unusual ductility after heat-treating at 2000°-2100° F. They are readily welded by spot, resistance, arc and acetylene methods. For drawing sheets special lubricants are used; such as a mixture of lithopone and linseed oil to which chalk and sulphur are sometimes added. For pickling solution use 8% H_2SO_4 and 2% HCl to be followed by a 20% HNO_3 bath. (Acid percentage by volume.) Pickling temperature 130°-160° F. For polishing, use abrasive having a grit of 150-180 to be followed by 200 emery, 240 flour and alumina buffing compound. RHP (3)

Eutectic Cast Iron. B. Osann. *Bulletin British Cast Iron Research Association,* Vol. 3, Oct. 1931, pages 38-41.

It is emphasized throughout the paper that the pearlitic condition is the ideal condition to be sought if good castings with suitable mechanical properties are to be obtained. In addition, it is pointed out that for some services where corrosion is likely to be encountered, the uniformity of the pearlitic structure tends to eliminate the setting up of electric currents between the various constituents of the iron. The author's meaning of the word "eutectic" is derived from the Greek roots meaning "well made," and is not the usual interpretation most metallurgists put on the word. WAT (3)

Cast Chromium Steels in Wider Use. Electric Furnace Melting Processes Used for Corrosion-Resisting Alloys. H. D. Phillips. *Steel,* Vol. 88, Jan. 8, 1931, pages 39-43.

Ferrous alloys of Cr, or of Cr and Ni, fall into 3 groups: ferrites, martensites and austenites; the last being the desired solid solutions. High Cr content in steel reduces the per cent of C in the eutectic; raises the critical temperature; diminishes the rate of carbon diffusion; imparts the property of air hardening when the C content exceeds 0.1%. The addition of Ni to steel lowers the critical temperature, increases the hardness and strength without correspondingly decreasing the ductility and tends to produce a finer grain structure. The 3 types of Ni steels are: pearlites, martensites, and austenites. The presence of both Ni and Cr in steel is mutually beneficial. The addition of Ni to a high Cr steel produces an austenitic structure, as does also the addition of Cr to a high Ni steel. Austenitic alloys are fine grained, strong, tough, ductile, non-magnetic and highly resistant to both corrosion and machinability. The best method of producing high Cr and Cr-Ni alloy steels is in the electric furnace. The author describes both the acid and basic electric furnace processes with notes on pouring temperatures, heat treating and hardening practice. Tables are given to show the chemical compositions and physical properties of 6 typical alloy steels. JN (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Corrosion and the Life of Structures. *Engineer,* Vol. 152, Dec. 4, 1931, pages 599-600.

Editorial commenting on the work of the Corrosion Committee of the Iron and Steel Institute and other researches in progress at the present time. LFM (4)

The Corrosion of Metals. *Steam Engineer,* Vol. 1, Mar. 1932, pages 254-255.

General. AHE (4)

Grate Wear caused by Heat Given off from Upper Silesian Fuels. (Rostverschleis durch Wärmeeinfluss bei oberschlesischen Brennstoffen.) *Archiv für Wärmewirtschaft und Dampfkesselwesen,* Vol. 13, Jan. 1932, pages 7-9.

The investigations covered tests made to determine the composition of the rust, the cause of wear, the chemical and physical behavior of the fuel residue as well as the homogeneity of the material. The results of operating different plants under different conditions are compared. MAB (4)

Scientists Learn Effects of Cleaning on Metals. *Scientific American,* Vol. 146, Apr. 1932, pages 236-237.

The effect of disinfectants and cleaning on metals has been studied in Germany. Sheet samples of 40 different metals were immersed from 24-48 hrs. at certain temperatures in 24 disinfectants and cleaning solutions. The samples were carefully cleaned, loss of weight was determined and examined microscopically. Fe and steel were attacked by most of the solutions, and Cu was not much better. Zn was found to resist their action poorly, while Al and Al alloys were attacked by all acid and alkaline solutions. Tinned steel and tinned Cu were fairly satisfactory. Ni, Ni alloys, stainless steel and Cr plated steels were best. WAT (4)

The Constitution of Scale. L. B. Pfeil. *Engineering,* Vol. 131, May 15, 1931, pages 651-652.

Abstract of a paper read before the Iron & Steel Institute, London, May 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 248. LFM (4)

Corrosion and Welded Plates. *Petroleum World,* Vol. 28, June 1931, page 208.

From tests made and actual experience it has been found that the corrosion of welds and plates is practically similar. (4)

Corrosion of Cast Aluminum Alloys. W. O. Kroenig. *Transactions, Central Aero-Hydrodynamic Institute,* No. 91, 1931, 32 pages. In Russian.

Specimens for the investigation were prepared by casting into a chill 17 alloys both of the standard composition as No. 12, silumin and duralumin and those made by the addition to commercial aluminum of Cu, Mg, Mn, Zn, Sb and Sn, either in combination or separately. The castings in the shape of plates 250x170x15 mm. were cut into 2 corrosion specimens, one of which was machined all over, the other with the casting skin left intact, and corroded in a machine previously described (W. Kroenig, *Korrosion und Metallschutz,* 1930, page 25) using sea water to which some H_2O_2 was added. The attack lasted 15 days. Weight losses gave widely discrepant results. A comparison of the physical properties before and after corrosion was used as a criterion of corrosion resistance. All alloys containing Cu corrode badly and the corrosion is further increased by addition to them both of Zn and of Mn, while an addition of 0.2% Sb somewhat improves it at the expense of greatly reduced physical properties. 1% Sn added to No. 12 metal has no effect. Of the Al-Mg alloys, the most resistant is a 5% Mg alloy. The addition to 2.5% Mg alloy of 1.5% Mn considerably increases the resistance to corrosion and increases the strength of this somewhat weak alloy. The best results were obtained with the composition: 2.29 Mg; 1.85 Mn; 0.17 Sb. Theoretical considerations are advanced to explain the mechanism of corrosion. 18 photomicrographs are given. See also *Metals & Alloys,* Vol. 2, Nov. 1931, page 247. (4)

Chemical Corrosion of Lead in the Presence of Phenol (La corrosione chimica del piombo in presenza di fenolo). E. Da Fano. *Giornale di Chimica Industriale ed applicata,* Vol. 14, Jan. 1932, pages 18-21.

Buried lead corrodes rapidly; it is exceptional when it remains unaltered for 5 or 10 years. Protective coatings of coal tar containing anthracene oil, used on Italian telephone cables, were suspected of playing a part in accelerating corrosion. Laboratory tests indicated that such coatings, instead of delaying corrosion, may accelerate it, due to the presence of phenol which acts in a cyclic process as a sort of catalyzer, the lead phenolate formed being decomposed by CO_2 with regeneration of phenol. Besides having the proper consistency to keep out moisture, the coating should be as free as possible from phenol, even though phenol would not cause corrosion were moisture and CO_2 completely excluded. However, such complete exclusion is not commercially attained. HWG (4)

Non-Metallic Films which remain as residue in the Dissolution of Tin. (Nicht-metallische Häutchen, die bei der Auflösung von Zinn als Rückstand verbleiben.) A. Kutzelnigg. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 202, Dec. 24, 1931, pages 418-419.

The residue was determined as the substance between the metal crystallites, similarly to former tests with Cd. The amount of residue which shows a mesh-like structure was determined to be 0.0176% of the dissolved material. 7 references. Ha (4)

Autoxidation of Zinc. (Autoxydation des Zinks.) Al. St. Cocosinschi. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 197, Apr. 30, 1931, pages 270-272.

Chemically pure and somewhat impure Zn were left for 7 months in distilled water with more or less access of air. Zinc carbonate is formed whose content of CO_2 depends on the access of air. Pure Zn is not attacked if air is excluded, impure Zn is oxidized even in the absence of air. Water is not decomposed by chemically pure Zn. The autoxidation is greatly dependent on the disintegration of water. Ha (4)

Soil Corrosion. Wm. Thompson Smith (Ford, Bacon & Davis, Inc.). *Gas Age-Record*, Vol. 66, Dec. 20, 1930, pages 987-990, 997.

A paper prepared for the Bureau of Standards Second Soil Corrosion Conference, Dec., 1930. The 340-mile Amarillo-Denver natural gas pipe line was laid in 1927-1928 and protected in accordance with a corrosion survey. 2 years later it was inspected with, in part, the following conclusions. The substantial accuracy of the results of a soil corrosion survey as used by Ford, Bacon & Davis, Inc. is confirmed for alkali soils. The specifications of the degree of protection to be used on a pipe line is more exactly in accord with the actual requirements when based on a soil corrosion survey than when based upon surface inspection alone. The variation from the degree of protection necessary, as indicated by actual inspection after services, tends toward provision of excess coating in the case of a soil corrosion survey and toward inadequate protection in the case of surface inspection alone. Agreement by independent observers as to the degree of corrosiveness of the soil at any location is not absolute even when based on inspection data of pipe after service. It is unsafe to base a decision to eliminate protection at any point on the old method of simple inspection of the surface of the ground alone. It is relatively safe to base specifications of pipe protection on the results of a thorough soil corrosion survey. Substantial agreement in the comparative rating of soil samples as to relative corrosiveness, although a matter of judgment, is possible by independent workers. In the instance studied, soil corrosion survey specifications would have entailed an expenditure for pipe protection of 6.4% more than actually required. The actual construction program (although only in part substituting simple surface observations for a soil corrosion survey) expended only 75.1% of the amount actually required for adequate protection. This study has shown no one factor or small group of factors affecting corrosion which may safely be taken as an index of the comparative corrosiveness of soils at various locations. VVK (4)

Relation of Pipe Line Currents and Soil Resistivity to Corrosion. C. R. Weidner & L. E. Davis (Prairie Pipe Line Co.). *Proceedings American Petroleum Institute*, Dec. 1931, Section IV, pages 36-44; discussion, pages 45-52.

58 miles of 8" oil pipe lines in Oklahoma were examined for pitting, and the pipe line currents and soil resistivities measured. The authors conclude that there is some correlation between long line currents and corrosion. In general, galvanic currents gradually accumulate on pipe lines through soils of high resistance, and in most cases discharge from the lines in soils of low resistance. If current density is relatively high and the discharge is abrupt, deep pitting is usually experienced. They also conclude that there is considerable correlation between depth of pits and resistivity. Soil resistivities of less than 1,000 ohms are usually indicative of severe pitting. The discussion showed considerable disagreement as to the correlation of long line currents and corrosion. VVK (4)

The Deterioration of Structures in Sea-Water. Department of Scientific & Industrial Research. *12th Interim Report of the Committee of the Institute of Civil Engineers*, 1932, 28 pages. Price 6d.

Describes the work carried out during the year 1930-31 by the Committee, which has been investigating since 1916 the deterioration of timber, metal and concrete exposed to the sea. A large number of iron and steel test bars have been exposed for 9 years at 4 stations and the results of the latest periodical inspections are given. Reference is made to researches in the United States. (4)

Wrought Iron Piles Resist Salt Water for 50 Years. O. W. Degen. *Engineering News-Record*, Vol. 108, Mar. 17, 1932, pages 397-398.

Wrought iron piles exposed to sea water in San Francisco Bay for a half century were removed and were found to be in an excellent state of preservation. Inspection showed them to be covered with a protective rust scale tightly adhering to the Fe. CBJ (4)

Corrosion of Malleable Iron. F. W. Wolf & L. A. Meisse *Proceedings American Society for Testing Materials*, Vol. 31, 1931, Pt. 2, pages 422-433.

Includes discussion. See abstract of preprint, *Metals & Alloys*, Vol. 2, Oct. 1931, page 208. HWG (4)

Galvanic Corrosion on Cast-Iron Pipes. R. J. Kuhn. *Industrial & Engineering Chemistry*, Vol. 22, Apr. 1930, pages 335-341.

Cast-iron pipes, buried in soils in New Orleans are susceptible to corrosion due to electrolytic currents. This is overcome to some extent by a system of electrolysis drainage, which causes a collection of current to counteract the discharging galvanic currents. (4)

Protection of Iron Against Corrosion. (Korrosionsschutz für Eisen.) *Metallwarenindustrie und Galvanotechnik*, Vol. 29, Feb. 1931, pages 141-142.

A brief discussion of plating with Cr, Zn, and Cd; required thicknesses of layers; best methods of plating with and without intermediary layers. Ha (4)

Standards and Exposure Tests for Plated Metals. Wm. Blum. *Brass World*, Vol. 27, Mar. 1931, pages 57-60.

A summary of conferences held in Chicago, Jan. 1931, on Standards and Specifications for the Electroplating Industry; also the inauguration of concerted action for a series of exposure tests of electroplated surfaces. A classification of electroplated products is suggested. Ha (4)

Keeping White Rust from Zinc-Coated Products. Wallace G. Imhoff. *Iron Age*, Vol. 129, Jan. 21, 1932, pages 232-235.

White rust has been found on practically all kinds of galvanized products. Chemical analysis shows it to be zinc oxide, zinc hydroxide and zinc carbonate. Corrosion products depend on various conditions. Causes and agents of corrosion are air, water, moisture, carbon dioxide, sulphur gases, chemical solutions, etc. Mechanism of formation of white rust seems to proceed first by forming the hydroxide which later changes to zinc oxide and carbonate. White rust formation may be avoided by eliminating as nearly as possible, all conditions that make formation of white rust possible and protection of zinc coating with some kind of air and moisture proof coating. VSP (4)

Pitting of Hydraulic Turbine Runners. ALBERT H. MYERS (Stone & Webster). *Electrical World,* Vol. 99, Feb. 13, 1932, pages 328-329.

Examples of installations that exhibit corrosion pits from spot oxidation and from electrolytic action are noted. The causes and corrective measures are pointed out. One cause is electrolytic action or stray electric currents, and another the faulty or, at times, imperfect design of the turbine runner discharge passages in conjunction with the draft tube. Several illustrations are included. WHB (4)

Prevention of Intergranular Corrosion in Corrosion-resistant Chromium-Nickel Steels. P. PAYSON (Crucible Steel Co. of America). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 464, Feb. 1932, 25 pages.

Reasons for the susceptibility of alloys of the 18-8 type to intergranular corrosion resulting from reheating to temperatures between 1000 and 1600° F. are discussed. An attempt was made to develop alloys that would be resistant to intergranular attack after having been heated for 10 min. in the dangerous range. Experimental melts containing from 0.09 to 0.17% C, approximately 8% Ni and from 18 to 22% Cr were prepared. One series of alloys contained from 0.80 to 4.02% W, another from 0.99 to 3.38% Mo, and a third from 0.66 to 1.88% V. One alloy contained 3.92% Si, another 0.70% Ti and another 0.87% Ti. Samples of each alloy were quenched from 1900 and 2100° F., and the magnetic susceptibility determined. Pieces of the quenched alloys were then reheated for 10 min. periods in the temperature range 1000 to 1600° F., and the susceptibility to intergranular corrosion determined by means of the Strauss solution. The susceptibility to intergranular corrosion did not bear a direct relationship to the magnetic properties. Increasing the Cr to 22% makes the steel resistant to all but the 1100° F. reheating temperature. Small amounts of W, with increased Cr, improved the resistance, but over 0.8% appeared to decrease the resistance. The addition of 1.87% Mo did not better the steel, but 3.3% did. Even 0.17% C with 3.3% Mo was resistant to deterioration when quenched from 1900° F., but less so when quenched from 2100° F. V, Si and Ti have some effect in retarding deterioration. The general subject of intergranular failure is discussed, and it is suggested that some of the addition agents cause the formation of ferrite, and furthermore that the carbides precipitate in this ferrite rather than in the grain boundaries where they may cause intergranular attack. Micrographs are given to prove this point. 8 references. JLG (4)

A Quantitative Method for the Estimation of Intercrystalline Corrosion in Austenitic Stainless Steels. J. J. B. RUTHERFORD & ROBERT H. ABORN (U. S. Steel Corp.). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 9 pages.

The electric resistance was used as a measure of intergranular corrosion. If the material is massive, small specimens ⅛ or ¼" thick and 2 or 3" long should be prepared. Wires or strips can be conveniently used. Samples were corroded by a boiling H_2SO_4-$CuSO_4$ solution containing 15 g. $CuSO_4 \cdot 5H_2O$ and 47 cc. concentrated H_2SO_4 per liter. Samples of ⅛" wire were kept in the boiling solution for 24 hrs. In 18-8 alloys susceptibility to attack was found to increase with the grain size. The effect of various tempering temperatures were studied. The resistance method was found to be very sensitive and to yield quantitative data with respect to the attack. 4 references. JLG (4)

Corrosion Studies of Cold Rolled Acid-Resistant Chromium-Nickel Steel. (Korrosionsversuche an Kaltgewalztem Säurebestandigem Chrom-Nickel-Stahl.) PAUL SCHAFMEISTER & ANDREAS GOTTA. *Archiv für das Eisenhüttenwesen,* Vol. 5, Feb. 1932, pages 427-430.

Tests in 13 and 61% H_2SO_4 made on 2 steel sheets, (1) 8.8% Ni and 17.6% Cr, and (2) 9.9% Ni, 17.1% Cr and 2.8% Mo cold rolled from 2 to 60%, without intermediate anneals. Corrosion resistance of non-rusting and acid-resistant Cr-Ni steels depends on breaking down of its passive protective layer. This passive layer re-forms very quickly, if it is once damaged or at all removed through mechanical or chemical action. Superiority of molybdenum Cr-Ni steel in cold H_2SO_4 is to be accounted for due to its greater tendency to become passive. Cold working without subsequent heat treatment decreases resistance towards acids. DTR (4)

Electrochemical Potentials of Nitrified Steels. SHUN-ICHI SATOH (Mitsubishi Zosen Kaisha, Ltd). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 447, Feb. 1932, 31 pages.

With the object of predicting the effect of nitriding on the corrosion of steels, single potential differences of un-nitrided and nitrided steels were measured. Steels of various analyses, including Cr-Al, Cr-Ti, and Cr-Zr, but not Cr-Al-Mo or Cr-V, were used. The potentials were determined in distilled water, sea water, saturated $CuSO_4$ and normal $FeSO_4$ solutions. After the nitriding treatment the steels that respond to the treatment become about 0.6 volts nobler in distilled water and about 0.2 volts nobler in sea water, but when first placed in $FeSO_4$ solution they are about 0.07 volts baser and finally about 0.03 volts. In saturated $CuSO_4$ nitrided steels had a potential of about +0.2 volts. The potential in $FeSO_4$ is very sensitive to traces of $Fe_2(SO_4)_3$. In distilled water nitrided steels become black, but do not rust to form the red hydroxide. 13 references. JLG (4)

Increasing Corrosion Resistance by Alloying. (Erhöhung des Korrosionswiderstandes durch Legieren.) A. FRY. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

In creating new corrosion-resisting alloys, not only chemical affinity and electrolytic potential must be considered, but also the mechanical and technological properties. Alloying must either increase the chemical stability or procure protective layers in case of corrosion attack. The consequences as to production and application of corrosion resisting alloys resulting from the above requirements are discussed. GN (4)

Corrosion-Resistance of Chromium-Nickel-Iron Alloys. (Korrosions-beständigkeit von Chrom-Nickel-Eisen-Legierungen.) E. WELLMAN. *Zeitschrift für Elektrochemie,* Vol. 37, Mar. 1931, pages 142-156.

Tests on the behavior of a range of Ni-Fe and Ni-Cr-Fe alloys in contact with sulphur dioxide, sulphur dioxide plus air (moist and dry), and sulphurreted hydrogen, hypochlorite solutions (with and without traces of Fe), phenol, tartaric acid and citric acid. The alloys used comprise compositions representative of Ni-Fe alloys, Cr-Fe alloys, alloys containing low Cr and high Ni, alloys of approximately equal Ni and Cr contents, and alloys with low Ni and high Cr. (See also Zeitschrift fur Metallkunde, Vol. 20, 1928, pages 269-279.) 11 references. Ha (4)

Non-Oxidizing Steels and Corrosion. (Aciers Inoxydables et Corrosion). J. GALIBOURG. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Nov. 1931, pages 547-559.

In the present study, the author examines only the high spots of the corrosion question and gives rapid indications of the characteristics of steels typically involved in this problem of corrosion. As this study is based only on information taken from the literature, it gives as a whole, a clear and complete survey of non-oxidizing alloys. GTM (4)

Rust and Acid-Resisting Steels from the Standpoint of the Chemical Engineer. W. H. HATFIELD (Director, Brown-Firth Research Laboratories). *Industrial Chemist,* Vol. 7, Nov. 1931, pages 435-437.

A short discussion of the advantages of austenitic Cr-Ni (18-8) steel in the brewing, dairy, and dyeing industries, with especial regard to maintaining color and flavor, as well as overcoming contamination. RAW (4)

Wear Resistant Materials for Steam Turbine Blades. (Verschleissfeste Werkstoffe für Dampfturbinenschaufeln.) E. HOUDREMONT. *Stahl und Eisen,* Vol. 52, Jan. 28, 1932, page 88.

Discussion of Ray's paper published in "Power," Vol. 73, 1931, page 804. The writer points out that the materials must be examined not only from the viewpoint of wear resistance but also from the angle of corrosion resistance, vibration resistance, non-sensitivity of the top surfaces, etc. See "Investigation of Materials to Reduce Steam Turbine Blade Wear," *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 6. DTR (4)

Effect of Heat Treatment on Corrosion Resistance of Stainless Iron. CLARENCE G. MERRITT. (Crucible Steel Co. of America). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 18 pages.

It is known that the mechanical properties of the "Chromium Irons" (less than 0.12% C and 11.5 to 15% Cr) are dependent on the heat treatment, but it has been assumed that heat treatment has little effect on the resistance to corrosion. Corrosion, tensile, hardness and impact tests were made on a series of quenched and tempered or rolled and tempered chromium irons. The corrosion resistance was measured by the U. S. Navy sea-salt spray test. On tempering the rolled or quenched alloys at 1000° F. a marked increase in susceptibility to corrosion resulted, while the hardness, impact resistance and proportional limit decreased. Tempering either above or below this temperature does not harm the alloys. The deterioration at 1000° F. was attributed to the precipitation of finely divided carbides. 7 references. JLG (4)

Location and Study of Pipe Line Corrosion by Surface Electrical Measurements. C. & M. SCHLUMBERGER & E. G. LEONARDON (Société de Prospection Electrique, Paris, and Schlumberger Electrical Prospecting Methods, New York). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 476, Feb. 1932, 24 pages.

Previous work and work now in progress on pipe line corrosion is reviewed. Corrosion may occur as: (1) Chemical corrosion, and (2) Electrolytic corrosion in which the attack of the metal pipe is due to stray electrical currents. In either case electrical currents are present and the intensity of these currents can be determined by measurements on the pipe. This method is not always applicable and is usually very expensive. A process was developed whereby the corroding currents could be determined from surface measurements. Methods are described by which the current flowing through the pipe, the conductivity of the ground, and the direction and strength of stray currents can be estimated from surface measurements. By suitable methods the autogalvanic currents can be separated from the stray currents. The depth of the pipe can also be determined from the electrical measurements. A study of the corrosion of a pipe line in a town near Paris is described. It was found that the end of the pipe was being corroded by return currents from a street railway, and this condition was corrected by the installation of a large earth bar at the end of the pipe. 14 references. JLG (4)

Determining the Corrosivity of Soils. E. R. SHEPARD (Bureau of Standards). *Oil & Gas Journal,* Vol. 30, June 4, 1931, pages T-40, T-43.

General discussion of soil corrosion, description of the Shepard soil rod and the correlation of the Putman, Corfield, and Legg tests. The author concludes that the measurement of soil resistivity is the simplest and most satisfactory test available to determine the corrosivity of soils and that such a test may be used as a rough index of the corrosivity of alkaline soils. No electrical test yet devised appears to offer a generally satisfactory index for the corrosivity of acid soils. VVK (4)

The Influence of Alien Metals on the Dissolving Velocity of Base Metals. (Der Einfluss von Fremdmetallen auf die Auflösungsgeschwindigkeit unedler Metalle.) G. TAMMANN & F. NEUBERT. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 201, Dec. 8, 1931, pages 225-244.

The H_2-evolution in the dissolving of metals and their solid solutions in acid was investigated and formulas developed which represent the dissolution velocity and take into account the influence of local elements formed by the presence of foreign metals; a rarer metal always increases the velocity of dissolution. Results for several metals and alloys are given. Ha (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Thermomagnetic Analysis and the A_0 Transformation in 0.75% Carbon Steel. R. L. Sanford & G. A. Ellinger. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 83-93.

See abstract of preprint. *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 35. HWG (5a)

Interpretation of the Electrolytic Part of the Electrical Conductivity in Amalgams and Other Alloys. (Zur Deutung des elektrolytischen Stromleitungsanteils in Amalgamen und anderen Legierungen.) C. Wagner (University of Jena.) *Zeitschrift für physikalische Chemie,* Sect. B, Vol. 15, Jan. 1932, pages 347-352.

An approximate formula is given correlating the diffusion coefficient and the electrolytic transference numbers with reference to diluted binary alloys. Measurements on Cd dissolved in Hg lead to a value of the same dimension as theoretically derived thus supporting the writer's assumption that the movements of metal ions and electrons in amalgams take place independently of each other. EF (5a)

The New Observation Methods on Crystal Growth. (Die neuen Beobachtungsmethoden des Kristallwachstums.) E. Herlinger. *Zeitschrift für den physikalischen und chemischen Unterricht,* Vol. 44, July/Aug. 1931, pages 148-159.

A special chapter is devoted to the preparation of single crystals from metals. 66 references. EF (5a)

The Micro-optical Investigation of Non-ferrous Alloys by Polarized Light. M. v. Schwarz. *Metallurgia,* Vol. 4, Oct. 1931, pages 180-186.

The effects of illumination by polarized light in the examination of a number of alloys is described. A Reichert microscope equipped with a polarizer and analyzer was used. Sulphides could be distinguished from oxides in Cu. Non-metallic inclusions and variations in composition in Cu alloys could be detected with polarized light while their detection with ordinary light was, at least, difficult. Polarized light was also advantageous in studying some Al alloys. Many micrographs, including 9 in full color, are shown. Contains 8 references. JLG (5a)

The Diffusion of two Metals into each other during the Formation of an Intermetallic Compound. (Die diffusion zweier Metalle ineinander unter Bilding intermetallischer Verbindung.) G. Tammann & H. J. Rocha. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 199, July 21, 1931, pages 289-305.

If grains of 2 metals are heated and pressed together they diffuse into each other. The possibility is discussed of an experimental decision of the question whether a crystal is in fact of singular composition, or if a series, though limited, of solid solutions exists. For the second case, the diffusion coefficient can be derived from the growth of the crystal, in the first this was not possible. Ha (5a)

Chemistry of Alloys. (Chemie der Legierungen.) A. Westgren. *Die Metallbörse,* Vol. 21, Dec. 9, 1931, page 2107.

Gives an extract of a lecture delivered on Nov. 3, 1931, at Berlin, before 5 combined German technical societies dealing with intermetallic compounds in binary systems. EF (5a)

Crystal Structure and Atomic Properties of Alloys Containing Transition Elements. Arne Westgren. *Journal Franklin Institute,* Vol. 212, Nov. 1931, pages 577-599.

Presented at meeting of Franklin Institute, Feb. 5, 1931. Bibliography of 32 references. Bahr's so-called transition elements consist of the series 21 Sc — 28 Ni, 39 Y — 46 Pd, 57 La — 78 Pt, 89 Ac — 92 U, and they are designated by enclosure in frames in his periodic table. The divergence between transition elements and other metals manifests itself in no less than 3 different ways in their metallic reaction products: (1) The transition elements alone are able to form phases with nickel-arsenide structure; (2) when the transition elements combine with H, B, C, or N, they give rise to reaction products with metallic properties, which is not the case with other elements. Provided the atoms of the transition elements in a phase of this kind are sufficiently big in relation to those of the metalloid, the resultant structure is of a simple kind, of the interstitial type; (3) in combination with Zn, Cd, or Al, at certain proportions, the transition elements give rise to phases having similar structure to β or γ brass. Present experimental results are too incomplete to furnish a coherent idea regarding the conditions prevailing. DTR (5a)

Secondary Structure and Mosaic Structure of Crystals. F. Zwicky. *Physical Review,* Vol. 40, Apr. 1932, pages 63-77.

A brief summary is given of some of the essentials of the theory of the secondary structure. This structure is very sensitive to external distributing effects which frequently cause the transition of crystals from thermally stable into thermally pseudostable configurations for which the terms mosaic structure is proposed. A discussion of the relation of the mosaic structure to the secondary structure is given. It is shown that several very fundamental causes are operative during the growth of crystals which endanger the formation of thermally stable configurations. The most important of these is due to the fact that on solidification the heat of fusion must be carried away from the growing surface. The resulting temperature gradient very often is great enough to produce plastic deformation in the crystals in *status nascendi.* Finally a short review is given which intends to show that the adoption of the conception of a secondary structure and the closely related mosaic structure provides an adequate basis for the understanding of the totality of phenomena which is characteristic for the solid state of matter. WAT (5a)

The Austenite-Pearlite Transformation and the Transition Constituents. Albert Sauveur. *Heat Treating & Forging,* Vol. 17, Mar. 1931, pages 250-251.

The author discusses the mechanism of the transformation of eutectoid steel from its austenitic to its pearlitic condition as it cools slowly through its thermal critical range. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 161. Ha (5a)

Practical Application of Electro-Chemistry to Modern Macrography. John H. Hruska. *Heat Treating & Forging,* Vol. 17, Nov. 1931, pages 1034-1037.

Electrolytic method of reproducing macrostructures is due to A. Glazunov. A fairly smooth section of the specimen is connected to the positive pole of a direct current and a sheet of unsized paper, soaked in a suitable electrolyte, is applied to the surface. The paper is laid on a plate of another metal free from oxides or corroded spots. Stainless steel is a suitable material. The plate is connected to the negative terminal. Ions liberated from the specimen pass into the electrolyte of the paper. If the solution is such that colored precipitates are formed, then an electrolytically deposited image of the specimen will be obtained. If the sample is homogeneous, the paper becomes uniformly colored. Heterogeneities produce marked differences in coloration. To obtain good results, electrolyte paper should not be extremely "wet" and unduly high concentrations of electrolytic solutions should be avoided. Voltage for ferrous metals should not exceed 2.5 volts; time of electrolysis should be from 10 secs. to 2 mins. For larger samples, several sheets of soft paper soaked in 5% NaCl solution and placed under the electrolyte paper will aid in obtaining a uniform coloration. Most generally used electrolyte for ferrous metals is 3-5% aqueous solution of $K_4Fe(CN)_6$. Table shows electrolytes used successfully for non-ferrous metals.

Metal	Electrolyte	Coloration	Remarks
Bi	KI	Dark grayish yellow	
Co	KNO_2	Greenish yellow	
Cu	$K_4Fe(CN)_6$	Red	
Pb	KI	Golden yellow	
Ni	$(CH_3)_2C_2(NOH)_2$	Rose	
Ag	$K_2Cr_2O_7$	Reddish brown	
Zn	$K_4Fe(CN)_6$	Pure white	Dark or black paper to be used

The author has developed an easily built, self-contained apparatus, comprising electrical equipment, compartment for electrolyte and salts, drawer for paper, tray for soaking and metallic plate with suitable electrical connection. The electrolytic method is of great practical value in reproducing macrostructures with delicate details. Non-metallic inclusions will appear as white spots on the paper. Neither mechanical nor thermal treatment affect the resulting prints. MS (5a)

The Lead-Zinc Eutectic. J. M. Hodge & R. H. Heyer (Purdue University). *Metals & Alloys,* Vol. 2, Nov. 1931, pages 297-301.

The authors present a microscopic and thermal study of alloys of Zn and Pb. The eutectic composition was found to be 0.50% Zn and 99.5% Pb, the eutectic temperature 318.2° C. Evidence is presented that Zn has a solubility of 0.05-0.06% in Pb. The hardness of these alloys was studied and it was found that Zn as the eutectic imparts a greater increase in hardness than as plates in the hyper-eutectic alloys. Micrographs show the structures studied and the technique of making the thermal study is described. WLC (5a)

The Effect of Slag Composition upon the Structure of Grey Cast Iron. E. Diepschlag & L. Treuheit. *Foundry Trade Journal,* Vol. 46, Jan. 7, 1932, page 5.

Extended abstract of an article which appeared in *Die Giesserei* (1931, 18, pages 705-710). See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 7. OWE (5a)

Crystal Structure and Disintegration of Lead. (Kristallgefüge und Disglomeration des Bleies.) Otto Haehnel. *Elektrische Nachrichten der Technik,* Vol. 8, Feb. 1931, pages 77-78.

Pb cast and cooled in a normal way possesses crystal grains of an average diameter of 8 mm. This refers to Pb of 99.997% purity, but the addition of 1, 2, or 3% Sn has little effect on the grain-size. The addition of 1% Bi reduces the grain-size by 2/3, 1% Sb reduces it by ¾, and 1% Zn, or 0.1% Cu reduces it by ⅞. The grain-size of the metal in Pb-covered cables also varies with the purity of the Pb—the largest grain-size is found in the purest metal, but other factors in the pressing operations may affect the grain-size, such as the rate of cooling after Pb leaves the press. Grain-growth of commercial Pb which has been cold-worked proceeds, in the absence of vibration, only very slowly at 18°-20° C., and is scarcely noticeable in a man's average lifetime. Increase of temperature, however, greatly hastens the rate of grain-growth. Sn 1/3% and Sb 1% or Cu 0.1% reduces the tendency for grain-growth to occur in worked Pb. The disintegration of Pb is not a direct result of the large size of the crystal grains, but coarsely crystalline Pb is more liable to disintegrate under the influence of vibrations set up, for example, in lead-covered cables, especially if the conditions are such that the temperature of the cable may be as high as 40° C. Such conditions would also cause failure of lead alloys as well as of pure lead. WHB (5a)

Crystallization of Copper from Molten Copper Chloride. (Die Kristallisierung des Kupfers aus geschmolzenem Kupferchlorür.) V. Sikvonen. *Zeitschrift für Elektrochemie,* Vol. 37, Feb. 1931, pages 80-82.

It was found that the crystallization of Cu from molten copper chloride in presence of metallic Cu takes place according to the thermic equilibrium dislocation of the system Cu-Cupro ions-Cupric ions, $2\ CuCl \rightleftharpoons Cu + CuCl_2$; the Cu precipitates in the colder parts of the molten salt. Ha (5a)

The Structure of Ferromagnetic Ferric Oxide. J. Thewlis. (National Physical Laboratory.) *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science, Series* 7, Vol. 12, Dec. 1931, pages 1089-1106.

Theoretical study. Ferromagnetic Fe_2O_3 has a cubic structure. Several references in the footnotes. RHP (5a)

A Critical Point of Zirconium. (Ueber einen Umwandlungspunkt des Zirkons.) R. Vogel & W. Tonn. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 202, Dec. 24, 1931, pages 292-296.

From a series of heating and cooling curves it was found that Zr has a transformation point at 862° C. which is connected, at cooling with a dilatation at heating with a contraction; the length of a Zr rod was changed at this point by 0.072% and its volume 0.22%. Below 862° C. there exists the known stable hexagonal α-zirconium, above 862° C. a stable and denser β Zr. Photomicrographs of the structure are reproduced. Ha (5a)

Segregation of Cementite From Austenite. ROBERT F. MEHL, CHARLES S. BARRETT & DANA W. SMITH. *Nature*, Vol. 129, Feb. 27, 1932, pages 313-314.

The formation of new phases in alloys by precipitation from solid solutions has recently been studied extensively. These studies have given experimental evidence indicating that when a precipitate forms as plates within a crystalline grain, the crystallographic plane to which the plate lies parallel is determined, not only by the lattice structure of the parent solid solution, but also by the lattice structure of the precipitate. If, as Hanemann and Schröder suggest, the formation of Widmanstätten figures—figures of segregation —in hypo- and hyper-eutectoid Fe-C alloys is determined only by the diffusion mechanism characteristics of interstitial solid solutions such as austenite, the Widmanstätten figure obtained in Fe-Ni alloys (meteorites) in which the solid solutions are purely substitutional in type should be radically different, yet the Widmanstätten figures in hypo-eutectoid Fe-C alloys and in meteorites are crystallographically analogous. Furthermore, if diffusion conditions alone determine the type of figure, it would be expected that all Widmanstätten figures formed by precipitation from solid solutions of one basic metal would be identical in form, yet the precipitation of the γ-phase from the Al-rich terminal solid solution in the Al-Ag system leads to the formation of plates parallel to the (111) plane, that of the $CuAl_2$ phase from the Al-rich terminal solid solution in the Al-Cu system forms plates parallel to the (100) plane, and that of the precipitate from the Al-rich solid solution in the Al-Mg-Si system forms plates parallel to the (100) and (110) planes. Although doubtless diffusion conditions affect the external form of a segregate from solid solutions somewhat, it seems certain that the external form taken by the precipitate and the orientation of the lattice of the precipitate are largely determined by crystallographic relationships existing between the 2 participating phases. WAT (5a)

On the Theory of Formation of Segregate Structures in Alloys. C. H. MATHEWSON & D. W. SMITH (Yale University). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 8 pages.

Discusses the mechanism of the formation of segregates such as the α phase in the β brass matrix. A table is given showing the crystallographic relationships of segregates to matrices for several alloy systems. 4 references. JLG (5a)

Solution of Various Mixture Problems by a Graphical Method. (Lösung verschiedener Mischungsaufgaben auf graphischen Wege.) U. RETZOW. *Zeitschrift für technische Physik*, Vol. 11, Nov. 1930, pages 495-500.

The constitutional diagrams of ternary systems are usually represented by an equilateral triangle. It is shown that the simple relations of the sum of the heights in an equilateral triangle can be extended also to any triangle. This makes it possible to apply such a construction for alloys composed of 2 or 3 elements. A few examples demonstrate the method. Ha (5a)

Metallography with Polarized Light. J. S. G. PRIMROSE. *Metallurgia*, Vol. 5, Nov. 1931, pages 9-11.

Briefly reviews microscopic studies of metallic materials with polarized light. Describes Reichert opaque illuminator for polarized light and gives directions for its use. 3 references. JLG (5a)

Etched Surfaces and Fractures. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*, Vol. 20, Dec. 1931, pages 79-80.

The writer comments on the use of macroetching and fracture examination in determining the soundness of metal. WLC (5a)

The Microscope as a Practical Aid in the Cast Iron Foundry. ROY M. ALLEN. *Transactions & Bulletin American Foundrymen's Association*, Vol. 3, Feb. 1932, pages 733-826.

The paper deals with the use of the microscope in studying cast iron and is followed by a detailed discussion of the structural constituents in various types of iron. An appendix gives general instructions on the use of the microscope. See also *Metals & Alloys*, Vol. 2, Aug. 1931, page 142. CHL (5a)

Variations in Microstructure Inherent in Process of Manufacturing Extruded and Forged Brass. OGDEN B. MALIN (Pennsylvania State College). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 9 pages.

Bibliography of 27 references. Part of a thesis on file at the college. Studied 60-40 leaded brass rod extruded at 1450° F. The front end of the extruded section had a coarser structure than the rear end. The same difference, but to a lesser degree, existed in the forgings made from the extruded rod. The front portions of long forgings also had the coarser structure. JLG (5a)

The Aluminum-Manganese System of Alloys. A. J. BRADLEY & PHYLLIS JONES. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Ser. 7, Vol. 12, pages 1137-1151.

Previous work is limited due to the difficulty in working with these alloys. The present investigation uses the X-ray powder method of investigation. Seven different phases are found and are summarized in the form of a preliminary equilibrium diagram. RHP (5a)

Babbits with Tin Base and Low Antimony and Copper. A. M. BOCHVAR & S. I. IRODOFF. *Tsvetnuie Metallui*, Sept. 1931, pages 1139-1147.

Alloys belonging to the Sn rich region of the ternary system Sn-Sb-Cu were prepared and studied microscopically. Below 6-8% Sb, the hard cubic β-crystals (solid solution of Sn and Sb) are absent; the soft ground mass consists of solid solution of Sn and Sb in which hard crystals of solid solution of Cu and Sn are embedded. The hardness of such alloys is somewhat lower than that of the alloys with higher Sb content (Charpy, 5-6% Cu; 10-12% Sb). Hardness measurements made at different times after casting showed that the alloys are practically non-aging. BND (5a)

The Constitution of Tellurium. K. T. BAINBRIDGE. *Physical Review*, Vol. 39, Mar. 1932, page 1021.

The isotopic constitution of Te has been determined by the method previously described. The work of Aston has been confirmed and extended. Additional isotopes of mass numbers 124, 123 and 122 were found with indications of an extremely faint isotope at 127. WAT (5a)

Structure & X-Ray Analysis (5b)

An X-Ray Camera for Powder Diagrams at Any Temperature. NELSON W. TAYLOR. *Review of Scientific Instruments*, Vol. 2, Nov. 1931, pages 751-755.

A cylindrical X-ray camera of about 57 mm. diameter has been designed which may be used for powder photographs (Hull-Debye-Scherrer method) up to 1000° C. or down to liquid air temperatures. Convenience in use is obtained by placing the film on the outside rather than the inside. Using a Siegbahn type X-ray tube with Cu or Fe anticathode and 15 to 20 milliamperes tubes current, good diagrams may be obtained in 10 mins. to 2 hrs. depending on the substance being investigated. The method permits the study of those crystal modifications which are stable at high or low temperatures but unstable at room temperature. Lattice constants may be determined to an accuracy of 0.2%. WAT (5b)

On a Method to Detect Inner Stresses (Ueber ein Verfahren zum Nachweis innerer Spannungen). F. WEVER & H. MÖLLER. *Archiv für Eisenhüttenwesen*, Vol. 5, Oct. 1931, pages 215-218.

Report of the Kaiser Wilhelm Institut für Eisenforschung. The physical principles of a simple method are described which permits the detection of hidden inner stresses by means of the X-ray Spectroscopy. A cobalt K radiation is used for the examination of the material to be tested. Simple mathematical relations exist between the deformations as detected by the X-rays and the stresses which have brought about the deformation. In order to determine the accuracy of the method, some preliminary tests have been performed. Stresses of a known amount were artificially caused in sheet strips by means of a small bending device. After it had been ascertained that the error does not surpass an upper limit of approximately 0.0001 A.U. units or 3.5×10^{-5} mm. more tests were made which showed that elastic stresses can be determined with an accuracy of $\pm$ 5 kg./mm.[2] It is not yet proven if this method, which has been developed on carbon steels, can also be applied for alloy steels. GN (5b)

X-Ray Analysis of the Gold-Tin Alloys (Röntgenanalyse der Gold-Zinn-Legierungen). S. STENBECK & A. WESTGREN (University of Stockholm). *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 14, Sept. 1931, pages 91-96.

The previous work done on the subject is briefly summarized in the introduction. The author's own investigation, achieved with Phragmen's modified X-ray camera and the Fe-K radiation, led to the discovery of a new phase β between 12 and 16 atomic % Sn, showing an hexagonal close-packed arrangement. The existence of 6 different phases in summary could be definitely proven in the Au-Sn system including the following intermetallic compounds: Au-Sn, $Au\text{-}Sn_2$, $Au\text{-}Sn_4$. The atomic structure of Au-Sn corresponds to a nickel-arsenide type pattern. ($a_1 = 4.314$ A.U. and $a_3 = 5.512$ A.U.) The powder photograms of $Au\text{-}Sn_2$ and $Au\text{-}Sn_4$ yielded a wealth of lines indicating a rather complicated structure. EF (5b)

X-Ray Examination of the Lattice Structure of the ϵ-Phase in the Copper-Tin System. (Röntgenographische Untersuchung der Gitterstruktur der ϵ-Phase im Cu-Sn-System.) J. O. LINDE. *Annalen der Physik*, Vol. 8, 1931, Series 5, pages 124-128.

The ϵ-phase of the Cu-Sn system with about 25 atomic % Sn has, in comparison with analogous phases, a very high electrical conductivity. According to a general law stated by Borelius, such phases should have a regular distribution of both kinds of atoms in the lattice. The author finds in the röntgenograms of ϵ-Cu-Sn numerous superstructure lines besides those due to the already known hexagonal lattice with 2 atoms in the elementary cell. These new lines are attributed to a hexagonal lattice having 16 atoms in the elementary cell and a and c axes twice as great as those of the original cell. Further elucidation of the atomic arrangement was not possible from the photographs obtained. Ha (5b)

On the Question of Allotropy of White Tin and the Equilibrium Diagram of the System Tin-Cadmium. YOSIHARU MATUYAMA. *Scientific Papers Institute Physical and Chemical Research, Abstracts*, Tokyo, Vol. 16, Aug. 1931, page 67.

An allotropy of white tin or that of Sn at a high temperature has often been assumed as existing but no positive evidence has yet been found. The author studied this problem by means of several physical methods of high sensitivity, i.e., by measurements of electrical resistance, thermal expansion, thermo-electromotive force, thermal analysis, X-ray analysis, etc. The conclusion was that such a modification of Sn does not exist. The equilibrium diagram of the system Sn-Cd was revised on the tin side. Ha (5b)

Accurate Determination of the Lattice Parameter of As_2O_3 (Präzisionsbestimmung der Gitterkonstante von As_2O_3.) F. LIHL. *Zeitschrift für Kristallographie*, Vol. 81, Jan. 1932, pages 142-147.

The evaluation of 3 Debye- Scherrer patterns gave for the lattice parameter of the cubic face-centered As_2O_3: $a = 11.0457 \pm .0002$ A.U. The density is 3.877. 2 references. GN (5b)

Why Crystals Exist. F. ZWICKY. *Proceedings National Academy of Science*, Vol. 17, 1931, pages 524-532.

The following scheme was proposed in order to understand the relation between structure-sensitive and structure-insensitive properties of the crystalline state. (1) The ordinary cohesive forces whose action radii are of the same order of atomic dimensions are responsible for the condensed states of matter, but are not characteristic for the crystalline state. (2) Transition from the liquid to the crystal can only be effected by the simultaneous coöperation of a great number of atoms in regard to a definite directional arrangement. (3) Several directional phenomena which depend on the coöperation of many particles are discussed briefly. (4) The coöperation phenomenon which is responsible for the stability of a certain crystal will not, in general, have the same symmetry character as the primary structure. It follows that the crystal as a whole cannot be represented by an ideal crystallographic lattice. A secondary structure must be introduced. The peculiar coexistence of perfection and imperfection which is found in most crystals can easily be derived. WAT (5b)

The Structure of Crystals. RALPH W. G. WYCKOFF. American Chemical Society Monograph. 2nd Edition, Chemical Catalog Company, Inc., New York, 1931. Cloth, 6 x 9 inches, 497 pages. Price $7.50.

Since the appearance of the first edition of this book, many important advances have been made in X-ray crystal structure analysis. The new edition, while covering essentially the same topics, has been largely re-written. Part I deals with methods of crystal analysis. The production and properties of X-rays are treated more fully than in the previous edition. The modern gas tube is discussed. The securing and interpretation of data is treated quite largely from the viewpoint of determining the precise atomic arrangement in selected samples. The metallurgist will find little discussion of X-ray diffraction as a laboratory tool for such purposes as the study of recrystallization or preferred orientation. Part II gives the results of crystal analysis arranged largely by structure types. The list of materials is quite inclusive, though the results are, of course, condensed. In all cases, however, references to the literature are given. Alloy systems are treated only in a bibliography, though certain definite intermetallic compounds are described. The book closes with a large, excellently arranged bibliography. This covers a much wider field than the book, and should prove valuable to the metallurgist. There are a large number of new figures, especially in the second part. The index is adequate. H. W. Russell (5b)-B-

Artificial Disinteregration by α-Particles. J. CHADWICK & J. E. R. CONSTABLE. *Proceedings Royal Society*, Vol. 135A, Feb. 1932, pages 48-68.

The protons liberated from Al when bombarded by α-particles from polonium have been examined. It has been found that these protons can be divided into 2 groups. The results are explained on the assumption that the α-particles can enter the nucleus through certain resonance levels. To explain the distintegration of Al it is necessary to assume that there are 4 of these levels. The positions and widths of these resonance levels can be deduced from the experimental results. WAT (5b)

Solid Solutions of Lead and Tin in Bismuth. ERIC R. JETTE & FRANK FOOTE. *Physical Review*, Vol. 39, Mar. 1932, pages 1018-1020.

Bi with maximum impurities totalling 0.046 including 0.01% each of Pb, Ag and S; Pb with maximum impurities of heavy metals 0.10%; and Sn containing 0.10% Pb were used in the determinations. There is a slight but measurable change in the Bi lattice when the saturated solutions of Pb or Sn in this metal are formed. The most striking fact is that the *a* axis decreases and the *c* axis increases which would thereby increase the inisotropy of the metal. This fact is possibly of importance in connection with the magnetic anisotropy discussed by Goetz and Fock, who found that differences existed in the atomic radii of single crystals of Bi and its alloys with Sn and Pb. It is somewhat surprising that both Sn and Pb which have respectively smaller and larger radii than Bi should both affect the Bi lattice in the same way. The volumes of the unit hexagonal prisms are Bi 210.83 = 0.07A³, Bi-Pb 210.85 = 0.11 and Bi-Sn 210.58 = 0.07. The decrease in the volume in the Bi-Sn case seems significant and in the right direction. The Bi-Pb results are inconclusive. These results are presented for their interest in connection with the problem of the magnetic properties of these substances but it is by no means even suggested that the slight variations observed in the lattice constants can account for the whole of the variations in the magnetic properties. WAT (5b)

Thermal Analysis of the System: Lithium-Silver. (Analisi termica del sistema litio-argento.) S. PASTORELLO. *Gazzetta chimica italiana*, Vol. 61, Jan. 1931, pages 47-51.

The system: Li-Ag has already been studied by X-rays. In the present work the same experimental method was used as in the thermal analysis of the system: Li-Ag, and the alloys were prepared in the same way. The following data give the atomic % Li in the alloy, the initial fusion point and the eutectic arrest of the temperature-% composition curve respectively: 0, 961°, —; 0.350, 943°, —; 0.801, 893°, 610°; 1.20, 820°, 610°; 2.10, 700°, 610°; 2.90, 670°, 610°; 4.01, 830°, 610°; 5.90, 950°, —; 8.78, 850°, 410°; 11.8, 623°, 410°; 12.6, 410°, 410°; 16.4, 450°, —; 20.4, 413°, 180°; 26.5, 370°, 180°. These data show the existence of 2 intermetallic compounds, $AgLi_3$, m. 450°, and AgLi, m. 955°. Three eutectics at 610°, 410° and 180° correspond to concentrations of 30, 70 and 100% atomic % Li, respectively. The last 2 eutectics at 180° preclude the existence of other intermetallic compounds or of solid solutions between the components. The alloys containing a high % Ag, i.e., above AgLi, were very ductile. To dispel doubt that might arise about an exact analogy between Ag-Li and Ag-Mg compounds because of the structural difference between Li and Mg, the crystal structure of Li-Al compounds (already known thermally) was studied by X-rays. Thus a Li-Al alloy of the composition LiAl, studied thermally by Müller (*Zeitschrift für Metallkunde*, Vol. 18, page 231) had, as evidenced by X-rays, not only the same structure as LiAg but also nearly the same lattice constant (3.23 A. U. for LiAl and 3.225 for LiAg). This agrees with fact Ag and Al have almost the same at. diam. (2.88 and 2.87 resp.) Ha (5b)

The Beta Transformation in Copper-Zinc and Silver-Zinc Alloys. (Ueber die Beta Umwandlung in Kupfer-Zink und Silber-Zinklegierungen. I.) M. STRAUMANIS & J. WEERTS. *Metallwirtschaft*, Vol. 10, Dec. 4, 1931, pages 919-922.

19 references. A Ag-Zn alloy containing 50 atomic % Ag was examined by means of X-rays at temperatures up to 550° C. The samples were in sheet form and were heated by means of a salt bath. The lines of the body centered cubic lattice of quenched β Ag-Zn alloys disappear at about 300° C. It is probable that the β transformation in brass is accompanied by a change from the orderly to the disorderly atomic arrangement at higher temperatures. In contrast to β brass, the transformation of β Ag-Zn alloys continues between 100° and 225° C. to the formation of a new phase This phase has a low symmetrical lattice structure and is designated γ. It is formed by a regular change of the body centered cubic lattice which apparently is reversible up to a certain point. Preliminary information about the transformation has been obtained from microscopic examination, hardness tests and X-ray photographs and the studies are being continued. CEM (5b)

Structure of Rolled Zinc. (Bemerkungen zur Walztextur von Zink.) M. A. VALOUCH. *Metallwirtschaft*, Vol. 11, Mar. 18, 1932, pages 165-166.

5 references. A piece of rolled sheet Zn. 3 mm. thick was reduced to .03 mm. by etching. X-ray photograms were taken in 14 directions and from these the pole figures of the base, the prism plane and the pyramid plane were constructed. Results compared with other investigators. CEM (5b)

Examination of Steel Structures by Gamma Rays has many Advantages. *Steel.* Vol. 89, Dec. 21, 1931, page 36.

See "Non-Destructive Testing by Gamma Rays from Radium," *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 36. Ha (5b)

On the Quantitative Determination of Retained Austenite in Quenched Steels. K. TAMARU & S. SEKITO. *Kinzoku no Kenkyu*, Japan, Nov. 1931, pages 595-607; *Science Reports Tohoku Imperial University*, Series 1, Vol. 20, 1931, pages 377-394.

The quantity of retained austenite in quenched steels was determined by means of X-ray analysis as well as by measuring their magnetic saturation values. In the X-ray analysis, the specimen was a thin rod, 5 mm. in diameter, on which a thin strip of gold had been longitudinally fixed, and the X-ray photographs were taken with the specimen rotating. An austenitic Mn steel specimen was also treated in the same manner. The intensity of the line of austenite in Mn steel was taken as a standard and the retained austenite in quenched steels of different C content was determined. The same results were obtained by the 2 methods, i.e., the measurements by X-ray analysis and by saturation magnetization, as in the following: for a steel of a given C content, the quantity of the retained austenite increases; reaches a maximum at about 1000° C.; then decreases as the quenching temperature is raised. The quantity of retained austenite is greater in case of oil-quenching than in that of water-quenching. The cause for this is said to be the accelerating effect of the thermal stress during quenching on the austenite $\rightarrow$ martensite transformation. In quenched specimens, when cooled in liquid air, the quantity of retained austenite is diminished. The residual austenite of a steel, containing 0.89% C., 4-5 mm. diam., quenched at 1000° C., is transformed to martensite when cooled in liquid air by about 1/3 in oil-quench and about ¼ in water-quench. KT (5b)

Spectroscopy of X-Rays. (Spektroskopie der Röntgenstrahlen.) MANNE SIEGBAHN. Second revised edition. Julius Springer Verlag, Berlin, 1931. Paper, 6½x9½ in., 574 pages. Price 49.60 RM.

No book could be more welcome than the entirely new edition of this great classic in the field of X-ray spectroscopy, or what may be termed the physics of X-rays. It would be expected that other branches of X-ray science such as the examination of materials would display far greater change in the course of more than eight years than the fundamentals of X-ray spectroscopy but as a matter of fact, progress in this field has been so great that the book has been entirely rewritten. The chapters present the following subjects: Short summary of the knowledge of X-rays up to the time of the von Laue, optics of X-rays, technique of X-ray spectroscopy, emission spectra, absorption spectra, the systemization and theory of X-ray spectra, extension of spectra to longer wave lengths, and the continuous X-ray spectra. Siegbahn has given, as would be expected, a remarkably complete survey of modern apparatus which has made possible the marvelous accuracy in measurement of wave lengths. Approved values for these wave lengths are given in full in extended tables. The theoretical treatment in terms of atomic structure is perhaps the only disappointing feature. The author has been confronted with the inadequacy of the Bohr theory which, of course, was a basis for theoretical discussion in the first edition and at the same time has been faced with the necessity of trying to relate experimental data with the modern quantum theory. Probably the very best presentation possible has been given when the uncertain status of present theories of atomic structure is taken into consideration. The laws of X-ray spectra are presented in terms of energy levels without any attempt to visualize any process within the atom or any structure of the atom beyond the usual equations. Naturally this presents more difficult reading than the theory as it existed in 1923. However, this volume must be considered always as one of the great classics in the field of X-ray science since the author is unquestionably the outstanding authority. Anyone interested in any modern phase of the science necessarily must have a copy of this book directly at hand. The book is excellently printed and bound and is practically entirely free from error. George L. Clark (5b)-B-

Studies upon the Widmanstätten Structure, III.—The Aluminum-rich Alloys of Aluminum with Copper, and of Aluminum with Magnesium and Silicon. ROBERT F. MEHL, CHARLES S. BARRETT & FREDERICK N. RHINES. *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 26 pages.

The methods of investigation were similar to those described in earlier papers (*Metals & Alloys*, Vol. 1, Dec. 1930, page 908; Vol. 2, June 1931, page 111). In the low-Cu alloys plates of $CuAl_2$ precipitated on planes of the form (100) in the parent solid solution. The precipitate was quite definitely in the form of plates and not needles. In the high Cu alloys (up to 6%) particles of the compound were also formed on planes of higher indices, but it was not possible to determine the form of the planes. Efforts to determine the orientation of the plates of $CuAl_2$ were unsuccessful, but some indication that the basal plane of the compound was parallel to the (100) plane of the solid solution was obtained. Alloys containing as much as 2% Mg_2Si were studied. In this system plates were precipitated on both the (100) and the (110) planes. In general, those on the (100) planes were thinner and longer than those on the other family of planes. Etching tests indicated that the precipitate was probably not Mg_2Si; it etched like Al_3Mg_2. X-ray diffraction patterns also indicate that it was probably Al_3Mg_2 rather than Mg_2Si. The same compound was precipitated in both planes. It is therefor suggested that age-hardening in Al-Mg-Si alloys is due to the Al-Mg compound, and not to Mg_2Si. The mechanism of formation of $CuAl_2$ is discussed. It is suggested that the (001) plane in $CuAl_2$ is parallel to the (100) plane in the Al matrix, and that the [110] direction in $CuAl_2$ is parallel to the [120] direction in the solution. 13 references. JLG (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

The Resistance to Wear of Carbon Steels. SAMUEL J. ROSENBERG. *Bureau of Standards Journal of Research*, Vol. 7, Sept. 1931, pages 419-428, *Research Paper* No. 348.

A study was made of the effect of heat treatment and C content upon the wear-resistance of C steels as determined by the Amsler machine (combined rolling and sliding friction under heavy pressures). See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 37. WAT (6)

Magnetic Analysis of Steel. *Electrical Review*, Vol. 109, Dec. 18, 1931, page 910.

Describes system developed by the Magnetic Analysis Corporation, New York. Two magnetizing coils having primary windings of the same number of turns are connected in series. A standard bar of steel, of similar section to that to be tested, is placed in the center of one coil and is inclosed in a tubular chamber, through which running H_2O is passed to prevent overheating by eddy currents. Bars to be tested are passed slowly through the center of the other coil by means of a motor-driven feed mechanism. There is a secondary search coil inside of each main coil, which can be changed to suit the size and shape of the bar to be tested. These coils are connected in series, but opposed to the primary coils so that induced currents tend to neutralize each other. The secondary coils are connected to the galvanometer of a visible type oscillograph. Gives typical curves obtained in testing various steels. Process is at present limited to mild-steel bars up to 2" diameter and alloy steels up to 3". MS (6)

The Change of Volume in Steel Produced by Deformation. *Metallurgist*, Apr. 1931, pages 53-54.

An extended abstract of a paper by H. Hanemann and R. Yamada in *Archiv für Eisenhüttenwesen*, Vol. 4, Jan. 1931, page 353. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 143. VVK (6)

Physical Tests for Cast Iron. JOHN SHAW. *Iron & Steel Industry*, Vol. 5, Oct. 1931, pages 3-7.

The need for simple International testing specifications is shown. Weak points in present testing methods are pointed out in that: strength values fall off as the center of a cast bar is approached in machining samples and shear values bear no constant ratio to tensile values so that as tensile values drop, shear values reach a point at which castings are passed which would be condemned by tensile or transverse tests. Objections to British specifications are given and a machine is recommended for testing shock resistance. CHL (6)

Testing for Magnetic Characteristics. B. E. STEVENS. *Bell Laboratories Record*, Vol. 10, Mar. 1932, pages 261-265.

Brief description of testing for permeability, residual induction and coercive force. HWG (6)

The Gyromagnetic Ratio for Paramagnetic Substances. W. SUCKSMITH. *Proceedings Royal Society*, Vol. 135A, Feb. 1932, pages 276-281.

The measurements for the gyromagnetic ratio for paramagnetic substances are given. These measurements include the Fe and rare earth groups. WAT (6)

Experiments with Leaf Springs. (Untersuchungen an Blattfedern.) H. STARK. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Dec. 19, 1931, pages 1521-1526.

This is a preliminary report of the Committee on Springs and gives some data on joining the leaves to form a spring, and on the deflection, calculation of bending and deflection moments and distribution of tensions in the individual leaves. Ha (6)

Rockwell Hardness Testing of Metallic Materials. Proposed Method for. J. R. TOWNSEND. Report of A.S.T.M. Committee on Mechanical Testing *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 1, 1931, pages 595-598.

See abstract of preprint. *Metals & Alloys*, Vol. 2, Nov. 1931, page 255. HWG (6)

Yield Point of Structural Steel. M. O. WITHEY. *Proceedings of American Society for Testing Materials*, Vol. 31, Pt. 1, 1931, pages 136-140.

See abstract of preprint. *Metals & Alloys*, Vol. 2, Feb. 1931, page 36. HWG (6)

An Oscillation Method for Investigating the Strength of Crystals. (Über eine Schwingungsmethode zur Untersuchung der Kristallfestigkeit.) W. D. KUSNETZOW & E. W. LAWRENTJEWA (Physico-Technical Institute of Tomsk) *Zeitschrift für Kristallographie*, Vol. 80, Sept. 1931, pages 54-62.

A pendulum, having a steel prism at its lower end is placed on the crystal surface and the equilibrium is upset. The damping effect of the amplitudes is observed and taken as a measure of the crystal's hardness or strength. Tests correlating the crystallographic structure and chemical composition to the hardness disclosed: (1) the strength of the crystals increases with decreasing ion distances and increasing ion charges; (2) in the same series of salts, for instance in Ag-halides, the strength changes abruptly at the transition of the different space groups; (3) the strength of crystals secured from solutions is lower than the strength of crystals obtained from melts; (4) the damping of the same crystal proved to be dependent on the direction of oscillation. EF (6)

The Method of Damped Vibrations for the Determination of Hardness. W. D. KUZNETZOV. *Zhurnal Prikladnoi Fiziki* (*Journal Applied Physics*), Vol. 6, No. 1, 1929, pages 33-44.

The method consists in placing the point of the pendulum on the specimen to be tested, deflecting the pendulum to a definite amplitude, and noting the time **T**, or the number of vibrations N, in which the amplitude is reduced by a definite amount. The values of T and N are measures of the hardness. The oscillation period, in practice, is independent of the damping. The hardness series of metals obtained by this method coincides with that obtained by the scratch method. WHB (6)

Experiments on the Determination of the Buckling Stresses of Various Structural Steels. (Versuche zur Ermittlung der Knickspannungen für verschiedene Baustähle.) L. ILOSVAR. *Montanistische Rundschau*, Vol. 24, Feb. 16, 1932, pages 15-16.

The paper summarizes the principal results of investigations by W. Rein on the above subject. (W. Rein, *Berichte des Ausschusses für Versuche im Stahlbau*, Report 4, published by Julius Springer, Berlin.) GN (6)

On the Change of the Modulus of Rigidity in Different Metals. T. KAWAI. *Kinzoku no Kenkyu*, Japan, Jan. 1932, pages 38-56: *Science Reports Tohoku University*, Vol. 20, 1931, pages 681-709.

The change of the modulus of rigidity due to cold-working, such as stretching and drawing, was determined for various metals. A torsion testing machine was specially designed for the present work which can measure a torque accurately up to 600 mm. Kg. For measuring the angle of twist of the test piece, two small clips with mirrors are fastened to the test piece, and the rotation of each mirror is measured by a telescope. In Al and brass, the rigidity always decreases by cold-working; in Cu it decreases, till a minimum is reached after which the amount of decrease gradually diminishes with an increasing degree of cold-working; in Ni the rigidity increases rapidly at first but after reaching a maximum it decreases gradually. The relation between the annealing temperature and the modulus of rigidity was determined for cold-worked Cu, Al and Ni. In Cu and Al the rigidity first increases gradually, then rapidly from a temperature where recrystallization begins to that at which recrystallization is completed, and after reaching a maximum the rigidity decreases with a rising temperature. In Ni the rigidity increases gradually up to the beginning of the recrystallization temperature, after which it decreases rapidly up to 700° C. and then slowly decreases. At 800° C. it recovers almost completely the value it had before cold-working. The change of the modulus of rigidity caused by cold-working was determined for Swedish iron, Armco iron, mild steel (0.10% C, 0.20% C and 0.39% C). The rigidity slightly decreases at first, reaches a minimum and afterwards increases. The effect of annealing on the modulus of rigidity of cold-drawn mild steel also was investigated. The rigidity increases gradually up to the annealing temperature, where recrystallization begins, that is 450° C., and then rapidly decreases up to 600° C. Above this temperature, the change is gradual and at 900° C. the rigidity recovers almost completely the value it had before cold-working. The above change of the modulus of rigidity caused by cold-working may be explained as the combined effect of three factors, that is, internal stress and rotation of crystal grains, both of which make the rigidity decrease, as well as the refining of the grain size which increases the rigidity. KT (6)

Magnetostrain and Magnetoresistance. L. W. MCKEEHAN. *Physical Review*, Vol. 38, Jan. 1932, pages 368-371.

The paper is one of those presented in a Symposium on Magnetization by the American Physical Society, Sept. 1931. The dimensions and electrical conductivities of a ferromagnetic body are affected in two ways by its magnetization. The conspicuous effects at temperatures far below the Curie points are anisotropic. The anisotropic magnetostrains are most apparent in single crystal specimens. With reference to the direction along which the magnetization increases the longitudinal and transverse effects are opposite in sign. The longitudinal magnetostrain may be positive or negative depending upon the material. The longitudinal magnetoresistance is always positive. The conspicuous magnetostrains and magnetoresistance at or near the Curie point are apparently isotropic. The isotropic magnetostrain may be of either sign. The isotropic magnetoresistance is negative, that is, the resistance increases as the magnetization diminishes with rise in temperature. WAT (6)

The Graphic Calculation of Transverse Strengths. R. MITSCHE. *Foundry Trade Journal*, Vol. 45, Nov. 12, 1931, page 307,

An extended abstract, accompanied by 4 diagrams, of an article which appeared in *Die Giesserei* (1931, 18, 246). See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA9. OWE (6)

The Evaluation of the Bending Test in Cast-Iron. (Zur Auswertung des Biegeversuchs bei Gusseisen.) G. MEYERSBERG. *Krupp'sche Monatshefte*, Vol. 12, Dec. 1931, pages 301-330.

The particular suitability of the bending test for judging the quality of a cast-iron is explained and the nature of the process analyzed and definitions given. For the characterization of a material only those properties should be used which are independent of chance values which is expressed in dispersion of test values when plotted. The bending test conforms to this requirement. The magnitude of permanent deflection can be estimated from the shape of the bending curve, and the latter can be derived from the elastic line. In order to make possible a clear definition and comparison of different types of cast-iron a diagram is suggested which shows the tensile strength as abscissa and the bending number as ordinate; further are the "isoflexes" to be drawn in this diagram, that is the curves of equal bending product. The practical application of this diagram is explained. Ha (6)

The Faraday Effect in Ferromagnetics. H. R. HULME. *Proceedings Royal Society*, Vol. 135A, Feb. 1932, pages 237-257.

The rotation of polarized light transmitted through very thin films of ferromagnetics is discussed, using the ordinary simple model for a ferromagnetic. Owing to the importance of the exchange forces, each atom cannot be treated separately, but a fraction of the crystal containing a large number of atoms must be taken as a unit. For such a system are found approximate values for the possible wave-functions in the ground states when one quantum of light has been absorbed. This enables the energy changes and the matrix elements of the polarization for those (virtual) transitions occurring in the dispersion formula to be found. Owing to spin-orbit interaction in the excited states, these dispersion formulae are slightly different for left and right circularly polarized light. The indices of refraction are therefore different and a beam of plane polarized light suffers a rotation. With the very rough model used it was only possible to obtain the order of magnitude of the rotation. This is reproduced by the calculations presented, and for magnetization in the region of saturation it is found that the rotation is proportional to the magnetization, and increases with the wave-length of the light. Both of these results are experimentally true. WAT (6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Torsional Fatigue Tests of Cold-Drawn Wires. F. C. Lea & J. Dick. *Proceedings Institution of Mechanical Engineers,* Vol. 120, May 1931, pages 661-677.

Experiments were made with special machines which assure the breaking clear of the grips. Hard drawn, and quenched and tempered wires show a 20% greater safe range of torsional repeated stresses when the break is clear of the grips. Surface grinding of samples increases the fracture range 50%. Dry drawing is slightly less destructive than wet drawing. The higher the carbon content and the more the wire has been worked in the dies the more liable are cracks which will lead to failure under repeated stress. RHP (6f)

Fatigue Tests in Shear of Three Non-ferrous Metals. H. F. Moore & R. E. Lewis. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 236-242.

See abstract of preprint. *Metals & Alloys,* Vol. 2, Nov. 1931, page 257. HWG (6f)

The Fatigue Resistance of Spring Steels. G. A. Hankins & M. L. Becker. *Engineering,* Vol. 133, Jan. 29, 1932, pages 141-145.

Condensed from paper entitled "The Effect of Surface Conditions Produced by Heat Treatment on the Fatigue Resistance of Spring Steel" read before the Iron & Steel Institute, Sept. 30, 1931. See *Metals & Alloys,* Vol. 1, Dec. 1931, page 306. LFM (6f)

Properties of Alloys under Dynamic Stresses. G. S. von Heydekampf. *Conference on Metals & Alloys, Case School of Applied Science,* Cleveland, Ohio, Nov. 1931, Paper No. 16, 2 pages. Mimeographed.

The endurance limit of steel is usually about 45% of the tensile strength, but a limit above 110,000 lbs./in.^{2} is seldom met. Steels of tensile strength over 250,000 lbs./in.^{2} generally have lower endurance limits than 110,000. Non-ferrous alloys have endurance limits from 20 to 50% of the tensile strength. These percentages refer to endurance in bending. The endurance limit in torsion is only about half that in bending. The effect of notches on endurance limit is complex, as the same notch has vastly different effects on different alloys. The notch effect has to be found by test. It may be related to "dynamic ductility," i.e., "crackless plasticity" or "damping capacity," but is not directly related to static ductility or to ordinary impact tests. Cold working of the surface improves endurance under bending stress. HWG+Ha (6f)

Alternating Torsional Tests on Zinc Crystals. (Wechseltorsionsversuche an Zink-Kristallen.) W. Fahrenhorst & E. Schmid. *Zeitschrift für Metallkunde,* Vol. 23, Dec. 1931, pages 323-328.

Previous attempts to relate the fatigue limit with other properties of metals are reviewed and their inadequacy indicated. In order to study the question in a simple form single crystals of Zn (1 mm. diam.) were subjected to reversed torsional fatigue in a newly designed machine. After a given number of reversals of stress the shearing and tensile strengths, and elongations, were determined. It is shown that the threshold shearing stress to initiate slip in the basal plane of the Zn lattice, and the tensile strength, during the process of fatigue first increase, then pass through a maximum, and subsequently decrease. The maximum is passed long before the appearance of the first fissure. Thus the crystal at first became stronger, but after a period began to soften. It is suggested that the fatigue strength of a crystal be defined as the maximum stress at which an infinite number of reversals of stress is just insufficient to cause the strength of the material to pass beyond this maximum. RFM (6f)

Fatigue Tests of Low-carbon Steel at Elevated Temperatures. H. F. Moore & N. J. Alleman. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 1, 1931, pages 114-121.

See abstract of preprint. *Metals & Alloys,* Vol. 2, Oct. 1931, page 214. HWG (6f)

Fatigue of Metals. J. A. G. Stewart. *Mechanical World & Engineering Record,* Vol. 89, Feb. 13, 1931, pages 155-158.

The phenomena of the behavior of metals under the effect of stresses caused by loads which frequently fluctuate in value between certain limits, are discussed. The "fatigue of metals" is defined as the behavior of metals when subjected to repeated stresses. Repetition-stresses may be subdivided into: (1) tensile and compressive; (2) reversed bending; (3) alternating torsion; (4) repeated impact; (5) reversed plane bending. The principles of the Wöhler and Haigh tests are set forth and typical S/N curves plotted. These are shown to be similar in type to human endurance curves. The effect of rate of application of repeated stresses has little or no influence on the limits of stress. The only relation with other mechanical properties is that with tensile strength. The theory of fatigue discussed is that originally advanced by Ewing and Rosenhain. WHB (6f)

Slightly Decarburized Surface and Endurance. Correspondence from W. Rosenhain, London, England. *Metal Progress,* Vol. 21, Jan. 1932, pages 67-68.

The writer calls attention to the work of Hankins and Becker on the relation of endurance properties to surface decarburization. WLC (6f)

Modern Problems of Mechanical Vibrations. (Zeitfragen mechanischer Schwingungen.) W. Adrian. *Zeitschrift für angewandte Mathematik und Mechanik,* Vol. 11, Oct. 1931, pages 382-387.

The fourth report of a Committee for Mechanical Vibrations, Munich, 1931, refers to experiments in the Wöhler Institute at Braunschweig, carried out with the object of improving the physical properties of materials by special pressing and rolling treatments of the surface of alloys which are submitted to vibration stresses. The present communication refers to threads which later endured alternating bending stresses. EF (6f)

Corrosion Fatigue Tests on Various Staybolt Materials. H. L. MILLER. *Boiler Maker,* Vol. 31, Aug. 1931, pages 206-208.

Specimens of threaded staybolt material were tested in a cantilever type rotating-beam machine while subjected to a stream of running water at 150° F. This reversed-flexure test was designed to simulate service conditions. All specimens were tested at a stress of 18,000 lb./in.^{2} as computed for the section at the bottom of the thread by the ordinary flexure formula. The relative lengths of life for each material were taken as criteria of service value. Five specimens each for 10 metals were tested. The speed of testing was 1150 r.p.m., or about 1,650,000 cycles of stress per day. The results obtained were as follows:

Material	Corrosion-fatigue Life
Wrought Iron A	8 days 3 hr.
" " B	8 days 15 hr.
" " C	13 days 18 hr.
" " D	13 days 12 hr.
" " E	14 days 18 hr.
" " F	9 days 21 hr.
Toncan Metal	22 days 18 hr.
Nickel	18 days 23 hr.
Toncan Metal Treated	53 days 9 hr.
Nickel Treated	47 days 12 hr.

From tension and impact tests conducted on specimens of the materials the following physical properties, to be obtained by heat treating, are recommended for staybolts in locomotive fireboxes.

Yield Point	45,000-50,000 lb./in.^{2}
Tensile Strength	58,000-63,000 lb./in.^{2}
Elongation in 8-in.	18-23%
Reduction of Area	55-75%
Izod Test	75-100 foot-pounds
Brinell number	116-134

Staybolts showing elongation 10% below the A.S.M.E. or A.R.A. requirements have given satisfactory service in switching locomotives in a hard water district. It is noted by the reviewer that life under a given stress has not proven a very reliable criterion of endurance strength in many studies of fatigue of metals. However, under so low a stress as that used by Miller, life would seem a somewhat safer criterion of endurance service than would life under a higher stress. HFM (6f)

The Influence of the Condition of the Surface Condition on Stress Distribution and the Endurance Limit (Einfluss der Oberflächenbeschaffenheit auf den Spannungs verlauf und die Schwingungsfestigkeit). E. ARMBRUSTER. VDI-Verlag, Berlin, 1931. Paper 6x8¼ inches, 64 pages. Prices 7 RM.

Stress distribution in specimens having different shaped notches was studied on models by polarized light, and results illustrated by figures.

The effect of notches was studied on 3 steels of about 0.30% carbon: one plain annealed steel of 150 Brinell, another heat treated to give 160 Brinell and fine structure, the third a 3% Ni, 1½% Cr, steel heat treated to 270 Brinell; on 3 cast 8½% Cu aluminum alloys; one as cast, 2 heat-treated, and two 15½% Zn, 2% Cu aluminum alloys, one heat-treated and the other as cast.

Rotary beam endurance limits were determined by running specimens at stresses that would break them in 200,000 cycles down to those that would leave them unbroken after 2 million. (*Abstractor:* This is a very small number of cycles for tests on aluminum alloys.) The reciprocal of the number of cycles was plotted against stress instead of using the usual S-N plot. Endurance tests on unnotched bars so made and so plotted were compared with various formulae that have been suggested for approximation of endurance limit from static properties. None of the formulae fitted all the samples. Herold's formula fitted the steels within 5% but was from 70% to 110% off on 3 of the aluminum alloys. Short cut tests are discussed and dismissed as useless.

Various surface finishes: ground, turned and filed, were compared, on the steels, with polished specimens with the usual results. Cold working the surface improved the endurance of the softer steels some 25%, but only 5% on the harder one.

The cast aluminum alloys tested with the casting skin (green sand molds) had 7% to 22% lower endurance than with machined and polished surfaces. No notched tests were made on the aluminum alloy samples.

Similar notches were made in the steel specimens by pressing a cone into them and by a pointed drill also; in another set, by pressing in a notch (at one place, not all round the specimen) with a chisel; by cutting with a tool; and by grinding it in. The cone impression had no effect on endurance; the drill hole cut it 20% to 35%; the chisel notch about 10%; the cut notch 35% to 50% and the ground notch 40% to 55%. Similar notches made all around the specimen (a) by pressing a V edged hard steel disk against the rotating specimen and (b) by turning the notch gave, on the basis of the cross section at the base of the notch, an increase in endurance for 5% to 10% for the pressed notch and a decrease of 25% to 40% with the cut notch. The effect of notches formed so that the base of the notch is cold worked is, therefore, nearly balanced or even overbalanced by the improvement due to cold working. Shallow rounded notches ranged from no effect to a 20% damage. A hole 1 mm. in diameter normal to the axis of the specimen did 25% to 35% damage in rotary bending and 6% to 45% in torsion. The effect of an enlargement of the specimen connected by an 0.3 mm. radius fillet ranged from 2% damage on the softest steel to 30% on the hardest.

The depth and radius of the notch was studied briefly. Since the ground V notch located at one point on the surface produced the most damage, Armbruster suggests as a standard for the determination of notch susceptibility in endurance a 60° V notch 0.2 mm. deep ground in (the endurance specimen not being rotated so that the notch does not go all the way around) with a 60/100 Norton wheel with a sharp 60° angle; the wheel is dressed to the sharp angle before the cutting of each notch. H. W. Gillett (6f)-B-

ELECTRO-CHEMISTRY (7)

Electrochemistry and Electrical Engineering. G. W. VINAL. *Electrical Engineering,* Vol. 51, Apr. 1932, pages 238-242.

Fundamental electrochemical processes are discussed in a general way with typical examples for each given case. Included are: electrowinning of Zn (metal deposited from solutions derived from ores or other materials using insoluble anodes), electro-refining of Cu, electroplating and electroforming, electrolysis of fused electrolyes, electrolysis of brine and hydroxide solutions, electric furnaces and electrometallurgy. WHB (7)

Electroplating (7a)

The So-Called Acid Patent Covering Chromium Plating. (Das sogenannte Säurepatent betreffend Verchromung). D.R.P. 448,526. *Deutsche Goldschmiede-Zeitung,* Vol. 34, Aug. 15, 1931, pages 347-349.

Discusses chromium plating methods, the field covered by the above patent and the licensing in Germany for operation under this patent. JLG (7a)

Reads Print Through Five Metal Thicknesses. *Scientific American,* Vol. 146, Apr. 1932, page 251.

Ni has been made in such thin sheets that it is possible to read print through 5 thicknesses of metal placed a few millimeters apart. These Ni sheets were displayed at the Royal Albert Hall, London, during a recent exhibition. The thin sheets were made by electrodepositing Ni upon Cu and then plating Cu on Ni. The Cu was then dissolved away, leaving the Ni. Cu was required on both sides to equalize the stresses caused during the depositing of the Ni which might have ruptured the Ni film. WAT (7a)

Finishing and Galvanizing Aluminum (Die Oberflächenbehandlung und Galvanisierung des Aluminiums)). *Chemiker Zeitung,* Vol. 55, July 29, 1931, pages 579-580.

A review covering acid dips, alkaline cleaning solutions, polishing pastes, steel ball polishing in barrels, lacquering and metal spraying. Plating methods discussed are Ni over Fe, Cr over Zn, Ni direct from solutions containing glycerin, Cu direct and Cd which is claimed to be better than Cu or Ni on Al. CEM (7a)

Nickel Baths and Nickel Anodes. (Nickelbäder und Nickelanoden.) E. WERNER. *Zeitschrift für die gesamte Giessereipraxis, Das Metall,* Vol. 52, Mar. 1, 1931, pages 29-30.

An account of the composition and control of Ni baths is given and the need for high-quality Ni anodes emphasized. WHB (7a)

A Simple Method for Applying a Light Gold Coating. (Einfaches Verfahren zur Herstellung leichter Vergoldungen). THEWS. *Deutsche Goldschmiede-Zeitung,* Vol. 34, Aug. 15, 1931, page 351.

A description of a commonly used method of plating in which no external e.m.f. is required. Directions for preparing the Au solution are given. JLG (7a)

The Importance of the Potassium-Ferri-Cyanide Test. (Die Bedeutung der Ferricyankaliumprüfung.) EUGEN WERNER. *Oberflächentechnik,* Vol. 9, Feb. 16, 1932, pages 31-32.

The test consists in placing a piece of filter paper which has been moistened with potassium-ferri-cyanide on the Ni-plated articles to be tested for denseness of the deposit. After a very short time a blue spot appears on the filter paper where a pore is in the Ni; this is the case for Fe; if the article is of brass or Cu the spot is brown. The author warns, however, against drawing final conclusions on the quality of the plating from these spots; the kind of material on which the deposit is made, the concentration of the bath, and also defects of the ground material can cause spots which have nothing to do with the denseness of the deposit: Also the thickness of the deposit has an influence on the blue coloring of the test. Only if the ground material was very well polished is test reliable. Ha (7a)

Metal Coating. (Metallisation.) J. MICHEL. Desforges, Girardot et Cie., France, 1931. Paper, 4¾x7¼ inches, 200 pages. Price 18 Fr.

Recipes for metal coating are collected in this book, which deals chiefly with electroplating from the point of view of the small jeweler. The author is stated to be an "ingenieur chimiste," but he includes aqueous plating baths for the deposition of aluminum, even though the back cover refers to the "rigorous scientific spirit which governs the choice of the recipes." A worthless volume.
H. W. Gillett (7a)-B-

Barrel Rolling and Plating. R. J. O'CONNOR. *Monthly Review American Electroplaters Society,* Vol. 18. Oct. 1931, pages 5-13.

Includes discussion. Paper presented at the Rochester Convention, 1931, of the American Electroplaters Society. Operating details are given of (1) polishing small castings by rolling in horizontal barrel with sand, quartz or pumice and water; (2) ball-rolling with steel balls, soap chips and a little cyanide; (3) dry sawdust rolling to remove oil or grease and to polish screws, etc., using fine, hard sawdust; (4) "wet rolling" in an oblique barrel with sodium carbonate, cyanide and hydroxide, soap, etc., in water for tubular rivets, safety pins, eyelets, etc.; (5) barrel plating with brass, Cd, Cu, Ni and Zn. Whatever hardened parts and springs are to be plated in cyanide bath, the free cyanide content must be kept low to avoid blistering of the deposit. LCP (7a)

The Electrolytic Coating of Metals with Lead Peroxide and Its Anti-Corrosion Properties. (Die elektrolytische Ueberziehung der Metalle mit Bleisuperoxyd und ihre Anti-Korrosions-Eigenschaften.) G. BUCHNER. *Oberflächentechnik,* Vol. 9, Feb. 2, 1932, page 23.

Anodic black-coloring with lead-superoxide for metals is recommended as a simple method for mass articles like radio parts, cutlery, signs, etc. A flexible, well adhering and fine black coating can be obtained in a bath of the following composition: Water 1 l., sodium-hydroxide 40 g., lead 10.5 g., resorcine 0.001%; current density 0.003 amp./cm.^{2}, voltage at an electrode distance of 5 cm., 1 to 1.2 volts, temperature 60°C. Instructions for the preparation of the bath which is still improved by addition of tannin, are given. Ha (7a)

An Efficient Electrotinning Process. F. F. OPLINGER (Roessler and Hasslacher Chemical Company). *Metal Industry*, New York, Vol. 29, Dec. 1931, pages 529-532.

The composition of a tin plating bath is given as follows:

Sodium stannate	12 oz./gal.
Caustic soda	1 oz./gal.
Sodium acetate	2 oz./gal.
Sodium perborate	1/8 oz./gal.
Cathode current density	10-60 amp./ft.^{2}
Temperature	55-75° C.

Its preparation, operation, control and maintenance are described in detail. The cleaning and analytical procedures are included. PRK (7a)

The Electrodeposition of Chromium from Tervalent Chromium Salt Solutions. Part I. Chromium Chloride and Chromium Sulphate Baths. HUBERT THOMAS, STANLEY BRITTON & OLIVER BRENTWOOD WESTCOTT. *Transactions, Faraday Society*, Vol. 27, Dec. 1931, pages 809-826.

A description of experiments conducted with the view of ascertaining the conditions under which it is possible to deposit pure Cr having satisfactory mechanical properties, i.e., fine-grained, smooth, adherent metal. None of the conditions employed in the authors' experiments yielded such deposits. Their purity varied somewhat irregularly over a wide range. Even when the purity was high, the mechanical properties were poor. The behavior of the solutions examined when the hydrogen-ion concentration was varied showed that contamination of the deposits was likely to occur in such unbuffered solutions, since the evolution of hydrogen at the cathode tended to raise the pH to the point at which precipitation of basic matter became possible. Unless crystals of metal can be formed without enclosing basic matter, good desposits cannot be obtained. The authors point out that the effect of increased pH is in fair accord with the view that the higher the pH, the greater the possibility of Cr deposition and the greater the risk of precipitated basic matter on the cathode. These two conditions acting concurrently should cause a change in the character of the deposits which would result in a transient set of conditions under which relatively pure metal could be deposited. The time of electrolysis is an important factor owing to the fact that the quantity of current passed governs the change in hydrogen-ion concentration in the neighborhood of the cathode. The article is accompanied by 5 diagrams and 9 tables. OWE (7a)

The Chromium-Plating Methods for the Most Used Metals and Alloys (Die Verchromungsverfahren für die gebräuchlichsten Metalle und Legierungen). K. ALTMANSBERGER. *Oberflächentechnik*, Vol. 8, Dec. 1, 1931, pages 247-248.

The following tabulation shows the principal methods of chrome plating:

(1) For iron as base metal	(a) alkaline-Cu-Ni-Cr
	(b) brass-Ni-Cr
	(c) Ni-acid Cu-Ni-Cr
	(d) Zn-brass-Ni-Cr
(2) For brass as base metal	(a) Cr
	(b) Ni-Cr
	(c) Cu-Ni-Cr
(3) For cast Al as base metal	(a) Cr
	(b) Ni-Cr
(4) For red brass as base metal	(a) Cr
	(b) Ni-Cr
(5) For die cast Zn as base metal	(a) Cr
	(b) Cu-Ni-Cr
	(c) Zn-Ni-Cr
	(d) Ni-Cu-Ni-Cr
	(e) brass-Ni-Cr

The intermediary layers are selected according to the application. Protection against corrosion requires a minimum thickness of 0.025 mm. The intermediary layers are valuable for the reason that they increase the elasticity of the deposits (in the same manner as the veneer for wood). The method (c) for iron is particularly distinguished by high elasticity. General remarks on the treatment and selection are added. Ha (7a)

Chrome-Plating. (Ueber die Galvanische Verchromung.) E. BECKER. *Die Giesserei*, Vol. 18, Dec. 25, 1931, pages 953-954.

The advantages of Cr-plating are discussed, the principal reason for the rapidly increasing use is the great hardness of the coating; the following table shows the hardness for several metallic deposits:

Metal Coating	Brinell Hardness	Metal Coating	Brinell Hardness
Lead	3-5	Nickel	155-420
Cadmium	12-53	Cobalt	270-311
Zinc	40-50	Chromium	500-900
Copper	58-150		

The practice of applying intermediary plating with Cu or Ni or both and the reasons for it are explained and methods of obtaining good deposits described. With good intermediary plating a thickness of the Cr deposit of 0.0008 mm. is mostly sufficient. The price amounts in general to about 1.5 to 2 times that of a simple Ni plating. Ha (7a)

Plating on Zinc Die Castings. E. A. ANDERSON & E. J. WILHELM (N. J. Zinc Co.). *Metals & Alloys*, Vol. 2, Dec. 1931, pages 337-340.

2 reasons are given for the failure of plating: inadequate thickness and improper method for plating the material in question. The cleaning, rinsing and acid dipping operations of preparing the surface are discussed. The question of a proper primary coating is discussed; the writer presents as best the use of a Ni coating at least 0.0003 in. thick. The disadvantages and inadequacies of a Cu flash are described. Tests are reported showing 0.0003 in. thickness of Ni as necessary to give adequate protection and that greater thickness is without advantage. Testing the quality of electroplated work is discussed. WLC (7a)

Chromium Plating Pure Aluminum and Aluminum Alloys (Das Verchromen von Reinaluminium und Aluminiumlegierungen). K. ALTMANNSBERGER. *Chemiker Zeitung*, Vol. 55, Sept. 16, 1931, pages 709-710.

Due to the affinity of Al for O, direct chrome plating on Al is impossible and Ni is usually used as an intermediate layer. The procedure recommended is to polish the parts and electro-clean in an alkaline solution with reversed current at 7-8 volts for several mins. This roughens the metal and protects it against O. Rinse in clear water and dip in concentrated sodium zincate solution until a silver white Zn coating is obtained. The Zn solution is made by dissolving sheet Zn in 28°-30° Be NaOH. Rinse in water and plate in Ni bath for 1 min. at 2.5 amps./dm.^{2} and 4 volts, then for 30 min. at 1-1.5 amps./dm.^{2} and 2.5-3 volts. A used Ni bath is better than one freshly prepared. It should contain 10 kg. $NiSO_4$, 1.5 kg. acid sodium citrate, 1.5 kg. Na_2SO_4, 1 kg. H_3BO_3 and 250 g. citric acid/100 liters and have a pH of 5.5-6.0. Citric acid produces small crystals, a dense deposit and raises the polarization at the cathode. Then chrome plate at 40° C. for 20 secs. at 5-6 volts and for 3-4 mins. at 4 volts. Pieces plated in this way can be bent at right angles without flaking off the plating. CEM (7a)

Chemical Control of Copper Plating Solutions. L. C. PAN. *Metal Cleaning & Finishing*, Vol. 3, Mar. 1931, pages 217-222; Apr. 1931, pages 309-314.

The procedure of determining and the curves for reading off the Cu content of acid copper plating solutions are explained. Examples illustrate the method. Ha (7a)

Chromium Plating Notes. MEYER ROTER. *Metal Cleaning & Finishing*, Vol. 3, Feb. 1931, pages 151-152.

The influences on good chromium deposits of cleaning methods, lining of the plating tank with glass or lead, the pH of the nickel solution, etc., are briefly discussed. Ha (7a)

Preparing Work for Polished Chromium Plating. W. E. WARNER. *Canadian Machinery*, Vol. 42, Nov. 26, 1931, page 23.

Where Cr plating has to be polished, the preparation of the underlying metal is important. The article should be first polished with No. 46 emery, using a speed of 8,500 ft./min. Successively finer grades of emery should then be employed; no grease should be used with the emery. When buffing, a speed of 14,000 ft./min., at least, should be used; tripoli should be the abrasive and grease used as a lubricant. The piece is then cleaned in an alkali bath, rinsed and plated. If the part is to be plated with Ni or Cu first, it should be buffed before final Cr plating. If this procedure is used, the Cr plating will appear bright and polished on leaving the bath and at the most, only a slight buffing will be necessary. WAT (7a)

The Status of Chromium Plating. WILLIAM BLUM. *Journal Franklin Institute*, Vol. 213, Jan. 1932, pages 17-39; Extended abstract in *Metals & Alloys*, Vol. 2, Dec. 1931, page 365; *Foundry Trade Journal*, Vol. 46, Feb. 25, 1932, page 135.

Presented at Franklin Institute meeting Nov. 5, 1931. A birdseye view of methods and applications, and especially the limitations and probable future uses. Hardness is most striking physical property of Cr. No definite relations exist between hardness and wear-resistance. Cr-plated gages, subsequently heated to 300° C., yielded best service. There is a real need for comprehensive study of factors governing hydrogen content of electroplated Cr, and its effects upon properties of deposits. Color of Cr deposited from H_2CrO_4 is bluish white; reflectivity in visible spectrum is 65%, as compared with 90% for Ag, although Cr reflects much better than Ag in ultraviolet range; has high electrical conductivity but is not suitable for contacts due to presence of oxide film; Cr surfaces not easily wetted and hence soldering is difficult. Resistance to tarnish is most important chemical property, but Cr will not prevent corrosion of underlying metals such as steel. Good commercial Cr plating is done with insoluble Pb or Fe anodes, in H_2CrO_4 solution, containing small amount of sulphate, 250 to 400g. CrO_3/liter, and CrO_3/SO_4 ratio 100 to 200, temp. 45° C., current density 100 to 150 amps./ft.^{2} Poor throwing power has been overcome by (1) increasing distance between anodes and cathodes; (2) using parallel concentric or auxiliary anodes; (3) attaching to cathode a wire which acts as a "thief"; (4) using non-conducting shields to reduce excessive current density. Cleanliness and good ventilation are necessary in plating shop to avoid injurious effects upon workmen.
OWE + WLC + DTR (7a)

Calculations of Ampere-Minutes in Plating. CHARLES H. ELDRIDGE. *Metal Industry*, N. Y., Vol. 30, Mar. 1932, pages 111-112.

A set of 4 tables for alkaline Cu and Cd plating, and Ni and acid Cu plating is given, showing the relationship between thickness of deposit, ampere-minutes/ft.^{2} and current efficiency. An example of how to use them is given. PRK (7a)

Procedures to Preserve Alloys and Steels Against Corrosion by Atmospheric Agents. (Procedes de preservation des Alliages et des aciers contre les degradations causes par les agents atmospheriques.) *Bulletin de la societe chimique de Belgique et Recueil des travaux chimiques Belges*, Vol. 40, Feb. 1931, pages 129-143.

A lecture dealing mostly with Co and Cr electroplating. WHB (7a)

Electroplating Aluminum with Copper. (Die galvanische Verkupferung des Aluminiums.) R. WEINER. *Zeitschrift für Elektrochemie*, Vol. 37, July 1931, pages 349-356.

A process for electroplating Al with Cu proposed by H. Ginsberg is described and the conditions for testing a satisfactory deposit are laid down, micro-examination being especially useful. The oxide film on the Al is first removed, and the surface is roughened by anodic oxidation and chemical treatment; the Al is then plated in a cyanide bath, a good deposit being so obtained. Experiments showed that the conditions for successful plating lie within fairly narrow limits, and that exceeding those limits leads to a worthless deposit. Plating in a copper chloride HCl bath of varying proportions and concentrations has not yet been successful. The composition of the Cu plating bath is the following: $K_3Cu\ (CN)_4$, 40g., KCN, 1g., Na_2CO_3, 10g., Na_2SO_4, 20g., $NaHSO_3$, 20g., water, 1 liter. Ha (7a)

Competition, Technically and Commercially, between Electrolysis and other Methods of Metal Extraction and Refining. (Die Elektrolyse im technischen und wirtschaftlichen Wettbewerb mit anderen Verfahren der Metallgewinnung und Raffination.) H. WOHLWILL. *Metall und Erz*, Vol. 29, Jan. 1932, pages 1-9; *Chemical Age, London*, Vol. 26, Mar. 5, 1932, Metallurgical Section, page 14.

Contains 7 references. In 1930 electrolytic processes represent 8.5% of the world's Cu produced, 90% of world's Cu refined, 13.5% of the Pb produced, 28.3% of the Zn refined and 55.7% of the Cd refined. Local conditions influence the economy of refining methods. 99.9% pure Cu has become a necessity in the electrical industry and 99.99% Zn, electrolytically refined, is now available and commands a higher price. Ni and As have been the largest impurities in electrolytic Cu. As can be removed by treating the acid electrolyte with SO_2 under pressure. As_2O_3 precipitates and can be recovered 99% pure. Purer metals can be obtained by electrolysis, but the impurities in the form of intermediate products, sediments and solutions present greater problems. Pb is not produced so much electrolytically, but for complete removal of Bi it is the only available process. Bi is recovered by electrolysis in HCl solution, but contains some Ag. For Pb free from Cu, containing 1 to 2% impurities of As, Sn and Sb the Harris process is best. Electrolytic Sn production is not yet important. Although smelting of Ni is very complicated it is more economical than electrolysis. For very pure Ni electrolysis is required after smelting. CEM (7b)

Electrolytic Zinc Plant of the Sullivan Mining Co. W. G. WOOLF & R. M. MILLER (Sullivan Zinc Plant). *Mining Congress Journal*, Vol. 17, Nov. 1931, pages 624-627, 640.

First industrial plant using Tainton high acid, high current density electrolytic zinc processes, located at Silver King, Idaho. Present nominal capacity is 60 to 75 tons of cathode zinc every 24 hrs. Five 270-ton capacity reinforced concrete bins raise the concentrates from cars; at the normal rate of feed this is a 10-day supply for the roasters. Five 25-ft., 8-hearth Wedge roasters, each yielding 40 tons per 24 hrs., with special air-cooled rabble arms. A 14-inch Jacoby conveyor takes the calcines from the roasters to a 20-mesh Leahy vibrating screen, the undersize passing to 2 Dings-Wetherill magnetic separators by means of screw conveyors. Leaching is done in three 20′ × 13′ Woodstove, lead-lined agitator tanks, heating done by lead steam coils. 6 Bust filters take the leached pulp from a surge tank. The filters are the rotary internal pressure type, each 4′6″ i. d. × 40′ long. Electrolyte circulates continuously from the cells to a 42′ Pb lined balance tank, pumped by Antisell Pb lined pumps to 5 cooling cells. Inlet to cells is by hard rubber pipes and outlet through a hard rubber overflow pipe to sumps below. Each cell contains 20 Pb alloy anodes and 10 sheet Al cathodes, the anode being cast in a grid shape to permit better circulation with higher current efficiency. The electrolytic system is cells in each unit in series and cathodes in each cell in parallel. Cathode melting furnace is a small reverberatory, 15′ wide × 28′ long, charged through a swinging door at the top. At the flue end of the furnace built into the hearth are 2 wells from which Zn is ladled into 2 steel plate ladles suspended from a trolley. Mold racks are below the trolley beams, casting is by hand, each slab 60 lbs. The product averages 99.99+% pure, with .001% to .002% Cd, Pb, Fe, Cu. This pure Zn has 30% greater ductility than that of other high grade brands, also higher corrosion resistance, elimination of hot shortness to a large extent in the die-casting trade, thus decreasing cracking upon removal from molds, and greater tensile strength. The electrolytic Cd plant and dust recovery Cottrell plant are also explained. DTR (7b)

Contribution to the Fundamentals of Technical Zinc Electrolysis. (Beitrag zur Kenntnis der Grundlagen für die technische Zinkelektrolyse.) P. RÖNTGEN & R. BUCHKREMER. *Metallwirtschaft*, Vol. 10, Dec. 11, 1931, pages 931-936.

Contains 16 references. Hydrogen overvoltage and cathode potential measurements in pure Zn solutions with polished electrodes were made with current densities between 1 and 40 amps./dm.². In this region the deposit potential $E = a + b \times \log \frac{i}{q}$, where i = current density and q = cathode area. The constants a and b depend on the operating conditions. The tests covered the effect of time of measurement on cathode potential and hydrogen overvoltage, the surface condition of the cathode, temperature and acid concentration on hydrogen overvoltage, Zn content of the electrolyte, temperature, and acid concentration on the cathode potential of electrolytes containing Zn. The results of these tests are given in graphical form. The yield of Zn remains constant with an increase in current density in solutions of low Zn content, but increases in solutions with high Zn content, provided the diffusion rate in the solution is high enough. Increase in temperature and stirring are beneficial as they increase the diffusion rate. With increasing acid concentration the yield decreases, temperature being constant, the more so the lower the Zn content is. In weakly acid solutions a rise in temperature decreases the yield, but in strongly acid solutions it increases it. If the acid concentration and current density are raised at the same time, an increase in temperature has a beneficial effect on the yield. The effect of a change of one factor depends on the other factors. Potential measurements were also made with low current densities, below 1 amp./dm.². In this region the potential does not follow the equation. At about 0.5 amp./dm.² it falls vertically to the value of the Zn potential. With $ZnSO_4$ additions the drop is less pronounced. CEM (7b)

Development of Electrolytic Metal Production. (Entwicklung der elektrolytischen Metallgewinnung.) *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 22, Feb. 7, 1932, pages 74-75.

The paper describes German plants for electrolytic metal production with special reference to those of the Norddeutsche Affinerie, Hamburg. GN (7b)

Metallic Construction of Airplanes (La Construction Métallique des Avions. La Formille Britannique). G. R. HAMEL. *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, June 1931, pages 296-304.

General discussion of factors entering in fabricating tubes used in type "Bristol" airplane as developed in the Bristol Airplane Company, Ltd. GTM (9)

Crankshafts are Cast from Alloy Steels. H. M. HEYN. *Steel*, Vol. 89, July 9, 1931, pages 31-32, Aug. 13, 1931, pages 31-33.

A Ni-Mn steel with 0.34% C, 1.64% Mn, 0.65% Si, 0.035% P, 0.04% S and 0.7% Ni is used for these castings, which have an ultimate strength of about 100,000 lbs., a yield point of 60,000 lbs., elongation in 2 inches of 25%, a Brinell hardness of 190. Heat treatment and furnaces are described. Another example of a low-carbon cast crank shaft is described. Ha (9)

Fusion Welding and Its Use in Pressure Vessel Construction. W. D. HALSEY. *Boiler Maker*, Vol. 31, May 1931, pages 125-126.

The article deals with the attitude of the insurer of high-pressure vessels toward the process and the procedure to be followed in applying coverage for such installations. Ha (9)

Application of Gas Fusion Welding in Steel Structures. (Die Anwendung der Gasschmelzschweissung im Stahlbau.) W. HOENISCH. *Autogene Metallbearbeitung*, Vol. 24, Dec. 15, 1931, pages 372-374; *Die Schmelzschweissung*, Vol. 11, May 1932, pages 107-108.

A few examples of welded structures. Ha (9)

Phosphor Bronze—Its Electrical Properties and Applications. WILLIAM CRAWFORD HIRSCH. *Electrical Manufacturing*, Vol. 8, Dec. 1931, pages 30-32.

In phosphor bronze, the phosphorus is a purifier mainly. It is present in very small quantities, and serves to rid the bronze of oxides. In electrical manufacture, this metal is used for bearings, and in switches for parts where strength and toughness must be accompanied by elasticity and resistance to corrosion. It is highly resistant to break-down under arcing conditions. Its tensile strength is as high as 130,000 lbs./in.². Many of its available forms and applications are enumerated. WAT (9)

Brass, Bronze and Copper Alloys. W. R. HUBBARD. *Conference on Metals & Alloys, Case School of Applied Science*, Cleveland, Ohio, Paper No. 4, Nov. 1931, Mimeographed, 7 pages.

General statement as to compositions of wrought alloys commercially available and some of their uses. Architectural uses are specially considered. No copper base alloy is resistant to tarnish in the atmosphere. The use of Everdur (96% Cu, 3% Si, 1% Mn) nails on shingles and clapboards is suggested to avoid rusting and loosening. It is also advocated for hot water storage tanks. HWG (9)

Light Metal-Alloy Pistons and Rods. BENEDICT J. ISIDIN (Aluminum Co. of America). *Motive Power*, Vol. 2, Sept. 1931, page 22.

The speed of oil and gasoline internal-combustion engines has been brought into a higher range following the availability of improved materials and the necessity of obtaining increased output without sacrificing space and weight. This often makes it necessary to reconsider some points of design and to adopt better grades of material to solve the problems of higher heat stresses and increase in dynamic bearing loads. As a satisfactory means of reducing the weight, the author discusses the use of Al, allowing heavier sections, preserving the rigidity and removing any thermal difficulties encountered in the piston. WHB (9)

Savings in Running Expenses by Weight Reduction of Vehicles. Utilization of Aluminum Alloys for the Construction of Busses and Street Cars. (Betriebsersparnisse durch Gewichtsreduzierung bei Fahrzeugen. Zur Frage der Verwendung von Aluminiumlegierungen beim Bau von Autobussen und Strassenbahnwagen). A. M. HUG. *Zeitschrift des Oesterreichischen Ingenieur- und Architekten Vereins*, Vol. 83, Sept. 1931, pages 285-289.

The economical utilization of aluminum-alloys for various parts of transport system constructions are discussed and illustrated. See also *Metals & Alloys*, Vol. 2, July 1931, page 131; Nov. 1931, page 260. EF (9)

Light Alloys in Aircraft. H. W. GILLETT. *Conference on Metals & Alloys, Case School of Applied Science*, Cleveland, Ohio, Nov. 1931, Paper 19, 6 pages. Mimeographed. *Heat Treating & Forging*, Vol. 18, Feb. 1932, pages 98-101.

The paper deals with the principles of the engineering choice of materials for aircraft construction. Some of the properties of light alloys cannot be chosen arbitrarily; for instance, specific gravity, modulus of elasticity. On the other hand, properties like yield strength, in general physical properties of behavior in service, can be influenced at will by proper alloying and heat treatment. The designing engineer must select, from the choice the metallurgist puts at his disposal, that alloy combining in the happiest way the properties desired for his special purpose. The points of view entering and determining the choice for the various parts in an aircraft are briefly discussed. 4 main groups are singled out which are then dealt with in greater detail; namely, light alloys, comprising heat-treated Al of the duralumin type, Mg alloys, strong alloys comprising heat-treated alloy steels and cold-worked corrosion-resisting steels. See "Some Characteristics of Light Alloys for Aircraft," *Metals & Alloys*, Vol. 2, Jan. 1931, page 8. MS + HWG + Ha (9)

The Selection of Materials in Machine Design. W. TRINKS (Carnegie Inst. of Technology). *Rolling Mill Journal*, Vol. 5, Apr. 1931, pages 285-289.

An abstract of a paper presented before the Steel Founders' Society at Columbus, Ohio, Mar. 1931. Gives a comprehensive list of the construction materials used in machine design and discusses the principles of selection, properties, special applications, and particular uses of each. JN (9)

Wear of Trolley Bus Wires. *World Power*, Vol. 27, Feb. 1932, page 89.

There are 2 primary causes for the wear of trolley bus wires: mechanical friction and arcing between the collector and the wire. A communication from the Institute of Electrical Engineers of Japan based mainly on operating experiences emphasizes the importance of choosing material with a high melting point as well as with the necessary degree of hardness to resist mechanical friction. Cd Cu wire appears to give a life twice as long as hard-drawn Cu wire. Si Cu wire appears to possess the same degree of advantage. It is reported that the wear of the steel contact conductor of the armoured trolley wire was negligibly small and of the order of 310 square mils for 48,600 times passing the collector. WAT (9)

Chrome Vanadium Steel Pressure Vessels. *Vancoram Review*, Vol. 3, Jan. 1932, pages 7-12.

A number of analyses of steel for forging and heavy plates are given; they contain 1.0 to 1.25% Cr, 0.15 to 0.2 V and show a tensile strength from 70,000 to 105,000 lbs./in.^{2} and an elongation between 20 and 25%. A few containers of various shapes are illustrated. Ha (9)

Uses for the Rare Metals. *Scientific American*, Vol. 146, Apr. 1932, pages 248-249.

Metallic Ba (99.95%) has recently been produced as a commercial article, and is supplied to manufacturers in the motor car industry, where it is used in a high-Ni alloy. In the radio industry, the metal is used to clean up the last traces of gas in vacuum tubes. It is expected that the consumption will be increased to a substantial amount in the near future. Pure Mo is now used in the electrical and radio industries in many forms. Ce, when alloyed with Fe, Zn, or other base metals, produces pyrophoric alloys, which are used in pocket-lighters. Ce and ferro-cerium are also powerful reducing agents. Cs and Rb are used in the manufacture of photo-electric cells. Cs is also used in eliminating the last trace of gas from vacuum tubes. Recently, metallic Li has found use as a deoxidizing agent in refining Cu; it does not appreciably reduce the electrical conductivity of Cu. Metallic Ta is now available. Because of its resistance to corrosive action it has already found extensive use as a cheaper substitute for Pt and Pt-Au alloys in spinnerets for rayon manufacture. Tantalum carbide is proving to be an excellent cutting-tool material. Cb is now replacing Pt in the jewelry industry. It takes a very fine finish and may be colored in many hues by an electrolytic method. It is inert to most chemical reagents. WAT (9)

All-Metal Building for Richmond Public Works Department. *Engineering News-Record*, Vol. 108, Mar. 24, 1932, pages 441-442.

First structure of its type for office use in this country. It is a 2 story structure, with a frontage of 116′ and a depth of 50′. Structural steel frame is utilized with open-web joist floors and roof covered by pressed steel deck plates. The inner and outer walls make extensive use of Al. Construction details are included. CBJ (9)

Rail Durability. *Engineer*, Vol. 152, Dec. 18, 1931, page 659.

Abstract of article from the *South African Engineer*. In relaying one line of the South African Railway some 45-lb. rails dating back as far as 1868-1875 were removed and found to be in excellent condition. Steel sleepers dated 1895-1896 were found to have withstood the increasing weight and speed of the trains remarkably well. They were still free from rust. LFM (9)

Reduction of Weight of 300 Suburban Cars by the use of Light-Metals. (Allegement de 300 Voitures de banlieue par l'Emploie des Alliages legers.) *Revue d'Aluminium*, Vol. 8, Mar.-Apr. 1931, pages 1364-1370.

The construction of the cars with Duralumin, Alpex, and cast aluminum alloys is described. Ha (9)

Aluminum Placed on Trial in Hopper Cars. *Railway Age*, Vol. 92, Mar. 26, 1932, pages 516-518.

When the Alcoa Ore Company, subsidiary of Aluminum Company of America, recently placed in service ten 70-ton hopper cars with bodies made of Al, it definitely put the metal on trial as a material for freight car construction. The cars are of standard construction and design and contain approximately 12,500 lbs. of Al plates, shapes and castings. A saving of 21,200 lbs. of dead weight are accomplished over the usual steel type of construction. The materials which are incorporated in this new hopper car are the Aluminum Company's 17SO, 17ST, 4S¼H and 4S½H in the wrought condition, and 43 and 197-57 in the cast condition. WAT (9)

Electric Line Installs High-Speed Aluminum Cars. *Railway Age*, Vol. 91, Sept. 12, 1931, pages 403-404.

Practically complete Al structure is the principal factor in a weight reduction of 40,000 lbs./car. 35 cars of this type have recently been purchased by the Indiana Railroad System, which operates 5,000 mls. of track, largely in Indiana. The bodies and under frames are all Al; the cars are capable of a speed of 70 mi./hr. The cars are 46 ft. in length between bumpers. WAT (9)

Metal and Manufacture of Pipe Lines. *Petroleum World*, London, Vol. 28, July 1931, pages 215-223.

A detailed discussion of pipe line metals and their various advantages for use in oil lines. (9)

Large Uses of Steel in Small Ways. Vol. II. Penton Publishing Company, Cleveland, 1931. Cloth, 9 x 11½ inches, 80 pages. Price $2.50.

In 1923, Iron Trade Review, the predecessor of Steel, began the series of notes on the uses of steel in small parts, some 50 such uses being collected in Vol I, while Vol. II contains nearly 100.

These range from artificial limbs, through bottle caps, card tables, cork screws, hair clippers, lock washers, maple sap spouts, suspender buckles, tire chains, typewriter spools, wire lamp shades, etc., etc. The way the steel is used, the tonnage required, and an illustrative photograph are usually given.

These accounts are interestingly written, and should be of interest to manufacturers looking for new uses for metals. The tonnages required in some of the "minor uses" are quite remarkable. H. W. Gillett (9)-B-

Protection of Concrete by Metallic Coatings. (Schutz von Beton durch Metallüberzüge.) R. Grün. *Zement*, Vol. 20, Sept. 17, 1931, pages 855-858.

Tests during a period of 1½ years with concrete samples covered by a coating of (a) bitumen, (b) sprayed Zn, (c) triple Pb spray and (d) a five-fold Pb spray and submerged in H_2O, 5% HCl, 5% $(NH_4)_2SO_4$ and 10% $MgSO_4$ solutions. The mechanism of destruction in the case of bituminous coatings is said to be characterized by the formation of blisters caused by the diffusion of the liquid thru the semi-permeable coating (membrane) due to the osmotic pressure. This phenomenon does not occur with metallic coatings which exhibited a decided superiority which might even be furthermore improved if the surface of the concrete were given a smooth finish. Includes 14 illustrations. EF (9)

Wrought Iron Tubes. G. M. Gill. *Gas World*, Vol. 96, Jan. 16, 1932, page 49.

Letter to editor commenting on letter from Reginald Terrell in issue of the Gas World of November 21st. Gill discusses the advantages of distinguishing Armco iron and wrought iron in ordering material for manufacturing gas service pipes. MAB (9)

American Skyscrapers. (Le Gratte-Ciel Américain). Icre. *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Aug. 1931, pages 368-382.

A lecture before the "Societe des Ingenieurs Civils de France." Deals generally with the requirements for structural steels used in large buildings. GTM (9)

Federal Reserve Bank of Pittsburgh Utilizes Cast Architectural Decorations. Norman F. Hindle. *Foundry*, Vol. 59, Oct. 15, 1931, pages 26-29.

Many of the decorative features were cast in Al and Monel metal by the Harsch Bronze & Foundry Co., Cleveland. The metal used for the castings conforms to the following specifications: Ni, 67%; Cu, 28%; Fe, under 3.5%; Si, 0.75-2.0%; C, 0.15-0.25%; Mn, under 0.50%; S, as low as possible. The mixture used consisted of Michigan lake and No. 2 Albany and a cereal binder in the ratio of 35 parts sand to one of binder. Added dry metal is melted in No. 70 carbide crucibles in gas fired pit furnaces. Cores for Monel metal castings were made of the same sand mixture as the molds. VSP (9)

Investigation of American Condensing Systems. (Erfahrungen an amerikanischen Kondensationsanlagen.) K. Hoefer. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 13, Feb. 1932, pages 51-52.

Discusses the various alloys used for protecting pipes and pipe connections, e. g., an alloy of 70% Cu, 29% Zn, 1% Sn; Muntz metal; Al bronze (92.3% Cu, 7.7% Al); an alloy of 85% Cu, 14% Zn, 1% Sn; an alloy of 62.7% Cu, 37.3% Zn. Also considers the construction of old condensers as compared with the new ones of high capacity, the arrangement of the condensers, the chlorination of the cooling water, and the construction of the air pumps. MAB (9)

Cast Crankshafts Replace Forgings. H. M. Heyn. *Foundry*, Vol. 59, July 1, 1931, pages 57-58.

Crankshafts, connecting rods, etc., have been made by hot forging for many years. Steel castings made of an alloy steel of special analysis are now used for that purpose. Triple heat treatment imparts better properties. A Ni-Mn steel is used by the Industrial Steel Casting Co., pioneers in this field. 3 furnaces are used to heat treat castings; each uses a different fuel. Burners are manifolded to Venturi type inspirators. The waste products are vented through a series of flues built in the walls of the furnace. VSP (9)

Making the Steel Saddles for the Hudson Bridge Cables. II. Machining the Saddle Castings for Hudson River Bridge Cables. Sidney G. Koon. *Iron Age*, Vol. 128, Nov. 5, 1931, pages 1174-1177; Nov. 12, 1931, pages 1230-1233, 1281; *Foundry Trade Journal*, Vol. 45, Nov. 26, 1931, pages 329-330.

8 cast steel saddles, each weighing about 18 net tons, are used. They were made and machined by the Midvale Co., Nicetown, Philadelphia. Each casting was made from one ladle of metal from an open hearth furnace. The weight of the metal was about 165,000 lbs. in the largest molds, and 100,000 lbs. in the smallest. Pouring was from full open nozzle until metal was half way up the risers. To keep the cope from "floating," riser boxes were bolted to the flask. Each casting was left in the sand for about 5 or 6 days before the risers were burned off. Final annealing for 5 days at 1650° F. was followed by complete descaling. Chemically, the castings are of plain C steel, having about 0.25% C and 0.50-0.60% Mn. Machining of castings is important not only because of great size, but because of close tolerances demanded. Some novel methods which have been adopted in machining by making use of the existing equipment in so far as it was practicable are described. OWE + VSP (9)

Developments in Steel Construction. *Mining Journal*, Annual Review No., Feb. 13, 1932, page 16.

Uses of steel in mines are discussed. AHE (9)

Commercial Vehicle Bodywork in Aluminium. *Metal Industry*, London, Vol. 39, Aug. 1931, pages 180-182.

The progress is reviewed which was made lately in the use of light metals in freight cars, passenger coaches, busses, etc. Standardization of parts is advocated to accelerate delivery. Ha (9)

Steel Castings in Machine Tool Construction. *Machinery*, Vol. 38, Dec. 1931, page 247.

Due to the use of tungsten carbide and special steels greater strength is needed in machine frames, tool holders, etc. This may be secured by use of cast steel in place of iron. The physical properties of a low alloy cast steel used extensively today are: tensile strength 144,000 lbs./in.^{2}, yield point 126,000 lbs./in.^{2}, elongation 14.5%, reduction of area 37.5%, Brinell hardness 300, impact strength (Izod) 13 foot-lbs. RHP(9)

Time and Temperature in Metal Working. *Iron and Steel of Canada*, Vol. 15, Jan. 1932, pages 6-7.

An article, accompanied by 3 figures, in which a discussion of the use of Elinvar in the production of hair springs and monometallic, non-magnetic balance wheels occurs. OWE (9)

HEAT TREATMENT (10)

Thermal Treatment of Steels. W. R. Berry. *Electrician,* Vol. 108, Jan. 8, 1932, pages 34-37; Feb. 12, 1932, pages 215-218.

The underlying principles of heat treatment and the effect on design are discussed. Tempering, normalizing and engineering steels and thermal treatment and case hardening and other surface processes are discussed and the need of the use of the right steels pointed out. WHB (10)

Heat-Treating Modern Twist Drills. J. B. Nealey. *Steel,* Vol. 89, Dec. 28, 1931, pages 23-25.

Kind of steels used and the installation for heat treating are described. Ha (10)

Duralumin Requires Special Treatment. Maximum Resistance to Corrosion Obtained by Cold Water Quench. B. K. Price. *Steel,* Vol. 88, Feb. 12, 1931, pages 31-33.

A description of the aircraft factory of the Glenn L. Martin Co., Baltimore, Md. The heat treating of duralumin is performed in a nitrate furnace, fired with gas, at a temperature of 925° F. All duralumin is quenched in cold water to secure maximum resistance to corrosion. JN (10)

Maintenance of Pulverizer Parts. M. C. Carver. *Power,* Vol. 74, Dec. 22, 1931, page 893.

Heat treatment of coal pulverizer hammers increased life from 3 to 15 months. Surfacing or plating had no effect. AHE (10)

Heat Treatment and Cooling Method for Cast Tin Bronzes. (Zur Kenntnis der Wärmebehandlung und der Abkühlungsweise von gegossenen Zinnbronzen.) Hiroshi Imai & Masami Hagiya. *Memoirs Ryojun College of Engineering,* Vol. 4, May 1931, pages 99-110.

The effects of annealing upon the grain size of cast alloys and of cooling velocity upon the repression of the eutectoid in the β-solid solution were investigated by means of a differential dilatometer. Annealing above 500° C. produced abnormal expansion in alloys up to 15% Sn. Inner strains were easily removed by heating to 600° C. A 26% alloy was cooled in water at the rate of 5000° per min., in oil at 3000° per min., in air at 200° per min., and in a furnace at 10° per min. Cooling at 5000° per min. decreased the Brinell hardness, at 200° per min. increased it. The tension set up by rapid cooling produced cracks in the test specimens. WHB + Ha (10)

Heat Treating Costs Assume New Role of Importance. J. H. G. Williams (Henry Souther Eng'r'g Co.). *Steel,* Vol. 88, Jan. 15, 1931, pages 38-39.

During the past year the overhead cost of automatic heat treating equipment has been subjected to a closer scrutiny in the light of decreased production and the actual merits of special steels have been considered from a more rational viewpoint based on long-time service tests. Progress in the heat treating industry is shown by the rapid increase in the use of gas fuels, the development of several new types of continuous and semicontinuous furnaces for special purposes, wider interest in the control of furnace atmosphere, such as the use of hydrogen gas in normalizing and annealing processes, and the continued development and expansion of the nitriding process. The author cites the need of better methods and tests for determining the uniformity of heat treated tool steels. JN (10)

Hardening (10a)

Continuous Liquid Heat Treating Process. W. Gordon Park (Kelsey-Hayes Wheel Co.) *Heat Treating & Forging,* Vol. 17, Nov. 1931, pages 1065-1066; *American Gas Journal,* Vol. 136, Jan. 1932, pages 35-36.

Kelsey-Hayes Wheel Co. has installed continuous liquid heating equipment for the hardening of rear-wheel truck hubs. This displaces hardening by the batch method, using hand labor. Furnace was designed for a capacity of 90 hubs/hr. at a batch temperature of 1600°-1670° F. Combustion chamber temperature below the pot is about 1950° F. Pb hardening pot is 21" wide, 15" deep and 7.5 ft. long, supported on cast iron top plates by means of flanges cast integral with the alloy pot. Furnace is fired with diffusion and tunnel type burners, adapted to a supply of 530 B.t.u. gas. Hubs are placed in a specially designed carrier which is removably suspended from the furnace conveyor. They are taken through a preheater and are then lifted automatically over the Pb pot and immersed to a specific point for 197 secs. The hub is lifted out of the furnace and placed on a stationary support which suspends the hub ¾" on the lower end in the oil bath; the cycle is 1-5.5 secs. The inside of the hub is then sprayed for 29 secs. with NaOH; the spraying is automatically controlled. The hub is then completely immersed in an H_2O bath for about 5 mins. The lifting is done by means of a transfer mechanism. CBJ + MS (10a)

Flame Hardening of Rubbing Surfaces. Correspondence from G. Prachtl, Brandenburg, Germany. *Metal Progress,* Vol. 21, Jan. 1932, pages 72-73.

Describes a new process for surface hardening of shafts and gears. WLC (10a)

Annealing (10b)

Strip and Sheet Annealing in the Electric Furnace with Atmosphere Control. Wirt S. Scott. (Westinghouse Electric & Mfg. Co.) *Iron Age,* Vol. 128, Dec. 3, 1931, pages 1422-1425.

Great economies are accomplished in bright annealing of Fe and steel strips and sheets in electric furnace with artificial atmosphere control. By means of correct design uniform heat treatment is accomplished. Discolored surface may be due to air, oil and grease, or to excess of hydrocarbons in atmosphere. The longer the charge is in process of heating and cooling the greater the opportunity for oxidation. The problem of maintaining the same analysis of steel is of importance. The material may be affected by the kind of gas used for atmosphere control. The Westinghouse Elect. & Mfg. Co. has developed a bright annealing process, consisting of gas-atmosphere generating equipment, and an appropriate electric furnace. VSP (10b)

On the Variations of Dimensions Produced by the Annealing of Hardened Copper. (Sur la variation de dimensions produite par le recuit dans le cuivre écroui). A. Schweitzer. *Comptes Rendus,* Vol. 194, Feb. 1, 1932, pages 449-450.

In the course of a study on the manufacture of recoil cylinders for guns, it has been ascertained that Cu previously hardened shows variations in dimensions when it is subjected to annealing. The author has attempted to determine the relationship between the magnitude of these variations and the conditions of working and of annealing. The cylinders used as test pieces (cylinders 8 mm. in diameter and 30 mm. high $\pm$ 1/100 mm.) were manufactured by cutting bars 8 mm. in diameter, obtained by drawing. The bars were all produced from the same casting and did not differ from one another in hardness. The copper contained 99.963% Cu. Variations in the amount of deformation were obtained by varying the diameter of the annealed bar prior to final drawing. After manufacture the cylinders were submitted to an anneal at temperatures between 300 and 800° C. (time, 50 min.). This treatment served to ensure that an annealed condition corresponding with each temperature had been obtained. The annealing was in all cases carried out in nitrogen. Measurements of height were made on at least 10 similarly treated samples. It has been found that for Cu which has undergone a specific treatment and has then been annealed the variation in height is negative, nil, or positive, as the temperature is lower, equal to, or higher than a certain limiting value. This temperature, which is in the neighborhood of 600-650° C., increases as the amount of work decreases. Other things being equal, the change in height which occurs on annealing appears to be independent of the amount of work put upon the Cu when the temperature is below about 550° C. For temperatures above 650° C. the change in height is always positive. OWE (10b)

Use of Dissociated Ammonia as Atmosphere in Annealing Strips and Sheets. Wirt S. Scott (Westinghouse Elec. & Mfg. Co.) *Iron Age,* Vol. 128, Dec. 17, 1931, pages 1548-1551.

Discussion of the action of gases on metals in connection with electric furnaces and controlled atmosphere for annealing. The manner in which anhydrous ammonia, dissociated, may be used to advantage in producing atmosphere in which annealing can be carried out without danger of damage to the surface of the steel is shown. VSP (10b)

Bright Annealing Steel in Hydrogen. Floyd C. Kelley. *Heat Treating & Forging,* Vol. 17, Mar. 1931, pages 263-265; *Iron Age,* Vol. 127, Apr. 2, 1931, page 1082; *Fuels & Furnaces,* Vol. 9, Mar. 1931, pages 303-304.

Abstract of paper presented before the American Institute of Mining & Metallurgical Engineers, Feb. 1931. Deals with causes of oxidation of stainless iron and low carbon steel in hydrogen and methods of preventing it. See also *Metals & Alloys,* Vol. 2, Apr. 1931, page 82. VSP + Ha (10b)

Manufacture of Bright Soft Copper Wires. (Die Herstellung von blank weichen Kupferdrähten.) F. Freude. *Die Metallbörse,* Vol. 21, Oct. 31, 1931, pages 1929-1930.

The hard drawn Cu wires are annealed at 550°-650° C. in pots filled with charcoal for about 5 hours. The process and precautions, particularly the insurance of a most perfect seal so as to exclude the air, are considered. EF (10b)

Case Hardening & Nitrogen Hardening (10c)

Case Carburizing of Iron and Steel in Mixtures of Sodium Cyanide. (Die Einsatzhärtung von Flusseisen und Stahl in Cyannatrium- Mischungen.) M. Stromeyer. *Die Werkzeugmaschine,* Vol. 36, Jan. 30, 1932, page 25.

The article briefly discusses case carburizing with special reference to the salt mixtures used in cyaniding. According to the author the following salt mixture is best fit: 30% sodium cyanide, 35% sodium carbonate and 35% sodium chloride. This mixture has a melting point of around 635° C., is an excellent carburizer and is distinguished by a high stability of the sodium cyanide. The procedure to be used is outlined. GN (10c)

Surface Steel Plating and Hardening of Iron Ware. (Die Oberflächenverstahlung und-Härtung von Eisenwaren.) H. R. Reininger. *Metallwarenindustrie und Galvanotechnik,* Vol. 29, Mar. 1931, pages 261-266.

The principles of surface hardening and steeling are discussed and the treatment described in detail. Ha (10c)

Cause of the Abnormal Behavior of Steels during Case Hardening (Ursache des abnormalen Verhaltens von Stählen bei der Einsatzhärtung). F. Duftschmid & Ed. Houdremont. *Stahl und Eisen,* Vol. 51, Dec. 31, 1931, pages 1613-1616.

Whereas M. A. Grossmann (*Metal Progress,* Vol. 18, 1930, page 33) attributes the abnormality of steel to the oxygen content, the authors found this peculiar type of structure to be due to the following causes. In case hardening, electrolytic iron and powdered iron made of iron carbonyl, for 6 hrs. at 950° C., the specimens showed an entirely abnormal structure. Furthermore, steels made by mixing powder of iron carbonyl with purest soot of carbon-hydrogen gas and sintering these mixtures for 3 hrs. at 1050° C. showed an abnormal structure either after forging or after forging and subsequent normalizing. Hardening tests of these steels developed soft spots when hardened in water but were uniform when quenched in brine. Since the oxygen content of the steels varied between 0.0008% and 0.001%, oxygen cannot be the cause of the abnormal structure. It is shown that abnormal structure is brought about when the Ar'-transformation is high and the velocity of diffusion of cementite and its velocity of crystallization below Ar' is large. A high velocity of crystallization is obtained when the Ar' transformation is not greatly retarded, i. e., when there is only a slight hysteresis between Ac' and Ar'. For the very reason of the lowering of the A' transformation, no abnormal structure was observed in the above mentioned pure carbon steels when alloyed with Mn, Cr or other elements. 5 references. GN (10c)

Waste Gases Developed during Hardening and their Dangers (Beim Härten entwickelte Abgase und ihre Gefahren). FREITAG. *Oberflächentechnik*, Vol. 8, Dec. 1931, page 248.
Many of the so-called hardening powders have ingredients which develop noxious gases or even explosive mixtures in the hardening (nitriding) vessel. They should be directed so that, after opening, the operating force cannot inhale them except in very diluted concentrations which are not dangerous. Ha (10c)

Sliding Gears Hard Broached to Close Limits. E. F. DAVIS. *Steel*, Vol. 88, Apr. 9, 1931, pages 41-44.
A plug inserted while carburizing prevents shrinkage of holes. Ha (10c)

Nitriding Steels. H. A. DEFRIES. *Conference on Metals & Alloys, Case School of Applied Science*, Cleveland, Ohio, Nov. 1931, Paper No. 7, 6 pages. Mimeographed.
A correlated abstract briefly covering some of the ground more fully covered by Grossmann and Harder (*Metals & Alloys*, Vol. 2, Sept. 1931, pages 132, 150). DeFries states that the average nitriding cycle is now 36 to 48 hrs., and that the days of the batch furnace are numbered; continuous furnaces will soon be available in which nitriding can be done at a cost equal to that of case carburizing. HWG+Ha (10c)

Continuous Carburizing by Gas. R. J. COWAN. (Surface Combustion Corp.) *Metal Progress*, Vol. 21, Feb. 1932, pages 44-48.
The author describes the practical details of a continuous gas carburizing process recently developed in the laboratories of the Surface Combustion Corp. The process employs one of the lower hydrocarbons diluted with fuel gas. The mechanical features of the furnace are illustrated in a drawing. The chemistry of the carburizing reactions are briefly discussed. Advantages claimed for the process are close control by rapid analysis of gases drawn from the muffle, decreased cost from fuel and labor saving, and high rate of carburizing. WLC (10c)

Mechanism of Energizer Action in Carburization. R. A. RAGATZ & O. L. KOWALKE (University of Wisconsin). *Metals & Alloys*, Vol. 2, Dec. 1931, pages 343-348.
29 references. The authors discuss carburization with pure C on a physicochemical basis. The relations of partial pressures of CO and CO_2 at the C and steel surfaces are shown schematically. Current theories regarding the action of energizers are discussed. The evolution of CO_2 from the decomposition of carbonates as an explanation of the energizing action is shown to be erroneous. A theory is presented which states that a metal oxide whose power for absorption of CO_2 at the temperatures of carburization is sufficient to maintain a carburizing atmosphere at the steel surface will energize the carburizing process. Metal oxides or carbonates such as $CaCO_3$ and $MgCO_3$ which do not have this power will not energize carburization. The extreme energizing action of alkali carbonates, Li, Na, and K, is explained by the formation of some metallic vapor at the carburizing temperatures which is more effective as a CO_2 scavenger than the oxide. Ba and Sr oxides are not reduced to metal at carburizing temperatures but the oxides have a powerful scavenging action on the atmosphere, removing CO_2. A substance capable of catalyzing the C : CO_2 : CO reaction will energize carburization which accounts for the action of Ni, Co and Fe and other substances that have been found to have an energizing effect. Carbonate is not an essential constituent of an energizer. WLC (10c)

Selective and Localized Nitriding. Part VII of Nitriding of Steel and Iron Base Alloys. WM. J. MERTEN. *Fuels & Furnaces*, Vol. 9, Nov. 1931, pages 1243-1250.
Parts of the surface of fabricated articles can be protected from nitriding so as to permit subsequent machining by covers of Ni either held in place mechanically or plated or welded on. An electroplate less than 0.0005" thick is sufficient. Sn gives similar protection but most other metals and many non-metallic materials seem to promote the nitriding catalytically. Nitrided articles may be denitrided in a fused sodium-potassium chloride bath (50/50 ratio), thus permitting changes or additional machining. The denitriding is not disadvantageous to a subsequent renitriding. CMB (10c)

The Heat of Formation of the Nitrides II. The Nitrogenization Heats of Lithium, Aluminum, Beryllium and Magnesium. (Die Bildungswärmen der Nitride II. Die Azotierungswärmen von Lithium, Aluminium, Beryllium und Magnesium.) B. NEUMANN, C. KROEGER & H. HAEBLER. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 204, Feb. 9, 1932, pages 81-96.
The heat of formation was measured directly by heating the metals with N; the tests are described in detail. The heats of formation in cal. per mol were determined as follows: Li_3N 47,166, AlN 57,400, for Be_3N_2 133,470, and Mg_3N_2 116,000. The nitrogenization products dissolve only partly in water. In presence of Li_3N Fe, Ni and Co absorb more N than in the pure state. Ha (10c)

Nitriding Process in the Heat Treatment of Steel. H. M. GUSTAFSON. (General Electric Co.). *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1136-1139.
Paper read Sept. 11, 1931, before the Northwest Section, Society of Automotive Engineers. Explains nitriding process and discusses properties of the nitrided surface, furnaces used and history of the process. By nitriding the cylinders in the motor block, one automobile manufacturer has reduced their wear 20 to 1. Maximum resistance to corrosion is exhibited by the unpolished surface. As nitrided steel remains file hard to 1200° F., it is ideal for applications requiring high wear resistance at comparatively high temperatures. Electric furnaces are especially suitable for nitriding. There are 2 types, the box type and the vertical cylindrical type. A late development is the addition of sulphur to the composition. It is claimed that machinability is improved greatly without impairing other properties. Maximum surface hardness and case depth are obtained by a heating period of about 40 hr. Increasing the pressure of NH_3 considerably increases the depth of the case and also tends to decrease the surface hardness if the heating cycle is longer than 25 hrs. MS (10c)

JOINING OF METALS & ALLOYS (11)

Modern Methods of Soldering and Welding and the Testing of the Seams. (Neuzeitliche Löt-und Schweissverfahren und die Nachprüfung der erzeugten Nähte.) H. KLOPSTOCK. *Werkstattstechnik*, Vol. 25, Mar. 1, 1931, pages 131-135.
Methods for soldering and welding materials are described which permit joining all metals both with each other as with one another, and to repair defective castings. Recent processes of welding are described which give a higher welding speed and economy. A testing instrument which removes small parts of the soldered or welded part is described to test the quality of the seam. Ha (11)

Gas-Welded and Brazed Joints for High Nickel Alloys. F. G. FLOCKE, J. G. SCHOENER & R. J. MCKAY. *Paper presented to the 32nd Annual Convention of the International Acetylene Association*, Chicago, Nov. 1931, 6 pages; *Welding*, Vol. 3, Feb. 1932, pages 79-83, 91.
The use of the oxy-acetylene flame in joining Monel metal, pure Ni and Inco Cr-Ni is entirely practical for a variety of seams and forms of metal. The 3 essentials necessary to the satisfactory completion of a welding job are: (1) Correct materials—which includes welding rod, flux and material to be welded, (2) Proper setting up of a job which includes jigging so as to hold the work in place during welding, (3) Proper procedure. These essentials are well explained by the authors and concrete examples of the various types of welds are given. Proper methods of silver soldering and brazing of these alloys are also explained. Ha + TEJ (11)

The Jointing of Aluminium. *Metallurgist*, Apr. 1931, pages 60-61.
An extended abstract of a paper by U. Magnani & C. Panseri in *La Metallurgia Italiana*, Vol. 23, Feb. 1931, pages 85-101. See *Metals & Alloys*, Vol. 2, July 1931, page 132. VVK (11)

Some Practical Notes on Joining Aluminium. A. J. T. EYLES. *Engineer*, Vol. 152, Dec. 11, 1931, pages 618-621.
A practical article discussing the following methods of joining Al: soldering; welding; with a discussion of welding materials, cast welding, pressure welding, hammer welding, and electric welding; riveting, threading Al joints; flanging and seaming. A table is given enumerating the various fluxes used for Al welding and photographs are given showing examples of riveted and spot-welded material. LFM (11)

Comparative Loading Tests of Welded, Riveted, and Bolted Steel Floor Panels. FRANK P. MCKIBBEN. *General Electric Review*, Vol. 35, Feb. 1932, pages 107-109.
Comparative tests under similar conditions of loads showed the deflections least with the welded floor, the riveted next, and the bolted last. Concentrating a load of 8000 lbs. on 1 ft.^{2} of 1 span indicates again the least deflection for the welded floor. WHB (11)

Brazing (11a)

The Brazing of Hard Metals. (Widia) [Ueber das Löten von Hartmetallen (Widia).] C. AGTE & K. SCHROETER. *Werkstattstechnik*, Vol. 25, Aug. 1, 1931, pages 373-374.
In brazing the tips of hard metals to holding shanks the metal is to a certain extent changed; the amount of change is investigated for several brazing agents. The changed surface can be easily removed by grinding. Ha (11a)

Some Practical Notes on Solders and Soldering Fluxes. A. EYLES. *Metal Industry, London*, Vol. 40, Jan. 1932, pages 3-6.
Tables list the fluxes and compositions of solder to be used for various metals when soldering or brazing. Impurities, tools and methods are discussed. PRK (11a)

Can Brazing be Considered as a Satisfactory Means of Construction or Joining? (Kann die Härtlötung als einwandfreies Konstruktions oder Verbindungselement betrachtet werden?) A. KRAUSS, H. V. OTHEGRAVEN & F. WECKWERTH. *Schmelzschweissung*, Vol. 11, Jan. 1932, pages 20-21.
In connection with the article by Weckwerth (*Metals & Alloys*, Vol. 2, Jan. 1932, page MA 16) a few controversial points are discussed, especially the value of and the influence of the flux on the soldered parts. Borax is generally considered to be harmful. Emphasis is laid on proper after-treatment and a slight excess of oxygen in flame. Ha (11a)

Practical Experiences with Robusco Cast-Iron Brazing. (Erfahrungen aus der Praxis über Robusco-Gusseisen-Hartlötung.) FRIED. H. FLIESS. *Schmelzschweissung*, Vol. 11, Feb. 1932, pages 36-39.
The difficulties of welding of cast-iron due to inner stresses and formation of graphite are discussed and it is pointed out that often the preparation of the piece and the time spent is out of proportion to the value of the work. In such case hard soldering (brazing) with Robusco-bronze is recommended which, as tests have shown, produces a reliable joint which can be made at lower temperature and penetrates the metal readily to make a uniform joint. This is illustrated by micrographs. Ha (11a)

Welding & Cutting (11c)

The Oxy-Acetylene Welding of Copper Fire-Boxes of Locomotives. L. SACCOMANI & R. VERZILLO (Engineers to the Italian State Railways.) *Welding Journal*, Vol. 28, Dec. 1931, pages 371-373; Vol. 29, Jan. 1932, pages 11-13; Feb. 1932, pages 51-54; *Journal American Welding Society*, Vol. 11, Jan. 1932, pages 28-30.
The authors give reasons for difficulties encountered in welding Cu. Results of tests show that Cu welds made with electrolytic Cu filler without flux are satisfactory, having a tensile strength of approximately 21 kg./mm^2 and elongation of approximately 30%. Many Cu fire-boxes have been repaired by this method and several all-welded Cu fire-boxes built under careful procedure control. Welds are kept under close observation while in service. Part II. Cracks and splits in Cu fire-box sheets can be repaired by oxy-acetylene welding, using pure electrolytic Cu as filler. Cu bars thus welded show a tensile strength of approximately 21 kg./cm.^{2} and elongation of approximately 30%. Careful inspection of many repaired fire-boxes at frequent intervals has shown that this method of repair is satisfactory. Several all-welded Cu fire-boxes have been in service since 1927. The authors describe the welding technique necessary for this type of work. This third installment includes data on physical properties of oxy-acetylene welded Cu bars and comparative cost analyses of fire-box repairs made by welding and riveting. The authors show the economy of the use of welding in repair and construction of Cu fire-boxes. TEJ (11c)

Coal Mine Equipment Built by Welding. Joseph C. Coyle (Pikes Peak Fuel Co.). *Welding,* Vol. 2, Nov. 1931, pages 751-753.

The manufacture of truck and trailer bodies, trailer chassis, metal bins and chutes, sprags for mine cars and various other articles has made electric and oxy-acetylene equipment a profitable investment for this coal mining company. TEJ (11c)

Hot Welding for Speed and Quality. Gilbert E. Doan (Lehigh Univ.). *Metal Progress,* Vol. 21, Jan. 1932, pages 56-61.

A brief discussion of the physical chemistry and metallography of electric arc welding. Higher welding temperatures are made possible in modern practice by the use of cellulose covered wire. The combustion of the covering produces a reducing atmosphere which prevents the formation of the metallic oxides ordinarily occurring at the elevated temperatures required to attain a weld of high ductility. Ductility of low temperature welds is decreased by rapid solidification before occluded gases have an opportunity to escape. WLC (11c)

Strong Tough Welds Made Rapidly. Gilbert E. Doan (Lehigh University). *Metal Progress,* Vol. 21, Feb. 1932, pages 39-43.

A summary of the advantages of modern "hot" welding processes. The increased ductility and higher endurance limit of the coated electrode welds seems to be due to blanketing the metal from gases of the atmosphere and keeping the weld molten long enough for entrapped impurities to float out and escape. Peening and annealing of weld metal is discussed. WLC (11c)

All Welded Switching Locomotives. R. V. Devlin (General Electric Co.). *Welding,* Vol. 2, Dec. 1931, pages 813-815.

A description of recently completed Diesel-electric switching locomotives of which truck frames, underframes and cab structures were fabricated from structural shapes by arc welding. TEJ (11c)

Repair of Boiler by the Approved Welding Methods. (Dampfkesselreparaturen durch Anwendung der zugelassenen Schweissverfahren.) F. A. Birke. *Die Wärme,* Vol. 54, Mar. 7, 1931, pages 175-179.

Recent advances of boiler repair welding are recognized with reference to the physical properties of the seams. The elimination of stresses in electric arc welding and the large economical savings due to the application of welding are emphasized. The danger of boiler explosions owing to improper welding and the authoritative specifications and regulations are discussed. The experience gained on the repair welding of several boilers is considered and the results presented in 13 illustrations. EF (11c)

Welding Method Reduces Crusher Repair Costs. *Engineering & Mining Journal,* Vol. 131, June 22, 1931, page 560.

At the Moctezuma Copper Co. plant at Nacozari, Sonora, Mexico, crusher repair costs have been reduced by use of a new method on worn mantles of No. 8 McCully crushers. The new method of welding features the use of short manganese rods, curved to fit the circumference of the crusher mantles, which are welded carefully first to the worn mantle surface and then to each other, until the original mantle surface is restored. The procedure effects a 50% reduction in time, power and welding material. WHB (11c)

A Consulting Engineer Looks at Structural Welding. G. D. Fish. *Steel,* Vol. 88, Mar. 19, 1931, pages 34-35-38.

Advantages and economy obtained are enumerated and a general outline of the best procedure is given. Ha (11c)

The Welding Contractor in Steel Construction. Gilbert D. Fish. *Welding,* Vol. 2, Dec. 1931, pages 799-801.

Factors which are hindering the progress of welding contractors are: (1) lack of structural engineering knowledge; (2) unfamiliarity with the cost elements of steel construction, not excepting the welding itself; (3) absence of coöperation in group activities. The author believes that welding contractors have an opportunity to entrench themselves in the business of field welding for buildings; their success depends on efficiency and on establishing a reputation for reliability. TEJ (11c)

Welding Stainless Steel Sheets. A. Eyles. *Sheet Metal Worker,* Vol. 22, Nov. 13, 1931, pages 648-649.

The principal points for obtaining good welding results either with gas or electric arc-welding are briefly discussed, and a few examples are illustrated. Ha (11c)

New Welded Type Rail Bonds Interchangeable for Arc Welding and Gas Welding. H. H. Febrey. *Iron and Steel of Canada,* Vol. 15, Jan. 1932, pages 1-2.

An article accompanied by 5 figures describing a new type of rail bond which has the advantage of being applied readily with the oxy-acetylene flame or metal arc welding. The terminals in these new bonds are of solid steel butt-welded to the conductors and sleeves. The bonds are made by cutting the conductor to proper length, attaching split steel ferrules at each end, and then flash-butt-welding the parts together. OWE (11c)

Modern Electric Resistance Welded Pipe. J. S. Adelson & L. B. Grindlay (Republic Steel Corp.) *Journal American Welding Society,* Vol. 10, Nov. 1931, pages 9-13.

Paper presented at joint meeting of the Metropolitan Sections of A.S.C.E., A.W.W.A., and A.W.S., June 9, 1931. The authors describe the method of manufacture, physical characteristics of the product, tests applied to the welded pipe and some of its uses. Photographs of tests and photomicrographs of weld and base metal are included. TEJ (11c)

On the Cause of Boiler Failures. (Ueber die Ursachen von Dampfkesselschäden.) O. Bauer. *Die Wärme,* Vol. 54, July 25, 1931, pages 567-574.

Among the various causes responsible for the failure of boilers in service the following ones are discussed at length: the properties of the materials employed, the heat dissipation and manner of operation, and the type of the steam plant. In the second part of the lecture delivered before the Vereinigung der Grosskesselbesitzer, Dresden, 1931, instructive examples of imperfect welding work on boilers are given. The speaker critically discusses the potentiality of repair work performed by welding and touches upon the principal non-destructive testing methods for welded material. EF (11c)

Welding Testing Methods. (Prüfverfahren für Schmelzschweissungen.) K. Adloff. *Die Wärme.* Vol. 54, Nov. 23, 1931, pages 894-895.

Reviews the present state of both destructive and non-destructive testing methods in the fields of welding. EF (11c)

Survey of the Erecting of Collecting Tubes and Sectional Chambers. (Bauüberwachung von Sammelrohren und Teilkammern.) E. Block. *Die Wärme,* Vol. 54, Apr. 25, 1931, pages 322-325.

Experiences gained on the joining of the various parts of boiler systems are collected in this lecture delivered at the Meeting of the Zentralverband der Preussischen Dampfkessel Überwachungsvereine, 1931. EF (11c)

Oxwelding Speeds Repairs in the Power Plant. R. W. Boggs. *National Engineer,* Vol. 35, June 1931, pages 199-200.

Description of a few cases where savings in time and cost were obtained in repairing and dismantling of equipment. Ha (11c)

Development and Application of Fusion Welding in Pressure Vessels. C. A. Adams. *Boiler Maker,* Vol. 31, July 1931, pages 188-190; Aug. 1931, pages 217-218.

In an address before the American Boiler Manufacturers Association, an outline of the development of the various fusion-welding processes and their application is given with particular reference to pressure vessel construction. The methods for non-destructive tests of welded joints are discussed. Ha (11c)

Suggestions on the Thermit Welding of Rails. (Anregung zum Ausbau des aluminothermischen Zwischengussverfahrens für Schienenschweissungen.) D. I. Brewitt. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 86, Apr. 15, 1931, pages 200-201.

Referring to a previous paper of Reiter (See *Metals & Alloys,* Vol. 2, Apr. 1931, page 82 and Vol. 2, Nov. 1931, page 265) the author gives some additional information and furnishes some suggestions on the alumino-thermal welding of rails. Ha + EF (11c)

Rail Welding. (Das Aufarbeiten von Schienen.) Th. Wuppermann. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 86, Aug. 1, 1931, pages 327-329.

Feeling that electric resistance welding (butt welding) has not been adequately covered in a previous publication of Reiter on "The Present Status of Rail Welding" (See abstract above), the writer gives some supplementary knowledge on the subject. EF (11c)

The Mechanical and Structural Characteristics of Welds made by the Electric Arc with Standardized Types of Structural Steel. (Die mechanischen und Gefüge-Kennzeichen der im elektrischen Lichtbogen hergestellten Schweissen bei genormten Stahlsorten für Konstruktionen.) Blasic & Guglielmino. *Giesserei mit Giesserei-Zeitung,* Vol. 18, Dec. 4, 1931, page 923.

The question is discussed in how far normal profiles can be used for building up machine by welding. Values found in experiments for the welds ranged between 36 and 94 kg./mm.^{2} for tensile strength and 120 and 380 Brinell hardness. Ha (11c)

The Conception in Foreign Countries Concerning the Welding of Boilers and Pressure Vessels. (Einstellung des Auslandes zur Schweissung an Dampfkesseln und Druckgefässen.) E. Block. *Die Wärme,* Vol. 54, Nov. 28, 1931, pages 895-897.

The author summarizes the tendencies in the fields of welding pressure vessels and boilers with reference to the following countries: U. S. A., England, France, Italy, Switzerland, Poland and Belgium. EF (11c)

Arc Welded Construction Helps Insure District Heating Service. E. R. Benedict. *Heating & Ventilating,* Vol. 29, Jan. 1932, pages 50-51.

Arc welded piping has been found to have a tensile strength of over 60,000 lbs./in.^{2}, with the result that strong and desirable welds are obtained. From a contracting point of view also the use of arc welding results in economy and utility in the field. WAT (11c)

Rules for Fusion Welded Construction of Boilers and Pressure Vessels As recently adopted by the A.S.M.E. *Journal American Welding Society,* Vol. 11, Jan. 1932, pages 9-18.

The new rules make no reference to the method or process of applying the welding and undertake to regulate the quality of the welding only by critical tests of the finished product. The rules for welding pressure vessels are divided into three classes, based upon the intended use of the vessel. Class 1, which represents the highest type of construction is absolutely without limit as to size, working pressure or the contents. The requirements for this class, which are identical with those for construction of steam boiler drums, contain the most rigid safeguards relative to the application of the welding process. Tension tests, bend tests, specific gravity tests of weld metal, X-ray, hydrostatic and hammer tests are required for this class of construction. All Class 1 fusion-welded vessels shall be stress relieved. Class 2 provides for vessels with a maximum plate thickness of 1½", which are not to carry lethal gases or liquids, or be subjected to as severe conditions of service as those built under Class 1. Class 2 vessels must not carry liquids at a temperature of 300° F. or above, and the maximum operating pressure and temperature in this class are 400 lbs./in.^{2} and 700° F. Tests required for Class 2 are tension, nick-break, bend and hydraulic-hammer. Class 3 provides for vessels with a maximum plate thickness of ⅝", which are not to carry lethal gases or liquids, or be used for storage of gases or liquids at any temperature materially exceeding their boiling temperature at atmospheric pressure. The maximum pressure and temperature permitted in this class are 200 lbs./in.^{2} and 250° F. Tests required for Class 3 vessels are, tension, bend and hydrostatic-hammer test. Also included are permissible designs for welded head attachments and welded nozzle construction for pressure vessels. TEJ (11c)

WORKING OF METALS AND ALLOYS (12)

Melting & Refining (12a)

Surface Films. *Metallurgist,* Dec. 1931, pages 177-178.

The surface films referred to in this article are those formed on molten metals during melting, alloying and casting. The film formed on Al while protecting it from rapid dissolution when molten also introduces difficulties in melting scrap and in preventing the escape of H and other gases from the bath. This property of film formation on molten Al is also present in alloys containing as little as 2 or 3%. This film is probably not truly a thin layer of Al_2O_3 but is "diluted" either by quantities of the metal itself or possibly by the presence of some sub-oxide. With metals similar to Al, the behavior varies. Mg forms no continuous and adherent surface film either in the solid or the liquid states. Mg is also free from difficulties arising from the retention of gas and also does not confer film-forming properties on Cu and other alloys to which it is added. Be appears to form a particularly strong surface film both in the solid state and in the liquid condition. In spite of the fact that Be is chemically even more active than Al or Mg, the polished surface of the metal retains its brightness for a long time owing to the formation of a surface film and some similar properties appear to be conferred upon certain of its alloys. On the other hand, the surface film which is formed on alloys either of Cu or of steel, which contain only small amounts of Be is exceedingly tough and makes it difficult in some instances to melt down scrap from these materials. VVK (12a)

Remelting of Aluminum Scrap and Waste Metal. (Das Umschmelzen von Aluminiumspänen und Krätzen.) E. R. Thews. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Jan. 10, 1932, pages 25-26.

The article outlines the practice to be followed in remelting aluminum scrap. The scrap should be freed from oil, the iron parts should be separated by magnetic separators. Briquetting of the scrap is advisable in order to avoid losses through oxidation. Three various methods of remelting are described and data are given on the slags and fluxes to be used in remelting. GN (12a)

Experiences of Operation of Basic Bessemer Mills (Erfahrungen im Thomasbetrieb). *Stahl und Eisen,* Vol. 51, Dec. 17, 1931, pages 1561-1569.

Report 219 of the Steel Mill Committee of the Verein deutscher Eisenhüttenleute. The paper represents the discussion following the presentation of the Paper on "Dimensions and Operation of German Thomas Converters" in *Stahl und Eisen,* Vol. 51, Sept. 3, 1931, pages 1105-1134; Sept. 10, 1931, pages 1136-1148. The results of the discussion are summarized under the main headings: (1) mixers and operation of mixers; (2) dimensions, lining and preparation of lining of converters; (3) operation of converters, such as composition and weight of charge, metallurgical reactions with special reference to the effect of nitrogen, composition, amount and properties of slag, pouring practice and output. GN (12a)

Making Steel Castings by the Open Hearth and Bessemer Processes. (Herstellung von Stahlformguss in der Martingiesserie und Kleinbessemerei.) H. Springkämper. No. 16 in H. Hermann's series "Die Betriebspraxis der Eisen-Stahl- und Metallgiesserei. Wilhelm Knapp, Halle (Saale), 1932. Paper, 6¼x9¼ inches, 87 pages. Price 7.50 RM.

This small treatise gives a general introduction to the subject, but does not go into great detail on any topic. Few references are given, and the treatment as a whole is a bit sketchy, more suited to give a student a general idea of steel foundry practice than to add much to the knowledge of the practising foundryman. It deals with small open-hearth furnaces (12 tons) and producer gas equipment for firing them, with small (2 tons) converters, with refractories, with pattern design, gating, shrinkage, cracking, rates of cooling, heat-treatment, and with sand blasting.

Cast steels mentioned for wear resistance are

C	Si	Mn	Cr
.40	1.50	.50	—
.50-.55	1-1.20	.80	—
.50	.40	.70	1.10
.40	.35	.80	1.00, while .70 C, .70 Mn, 1.0 Si,

1.4 W is advocated for Pilger rolls. Ni Mo steels are cited as useful for high temperature service.

Brief sections on testing, on cost calculation, and a two-page index complete the book. Electric steel foundry practice is not covered, but another volume in the series is in preparation which will deal with this. H. W. Gillett (12a)-B-

The Effects of the Products of Combustion on the Shrinkage of Metal in the Brass Industry. C. Upthegrove & A. J. Herzig. *Engineering Research Bulletin,* No. 22, *University of Michigan,* Department of Engineering Research, Dec. 1931, 66 pages.

The investigation had as its objective: first, the determination of the mechanism by which the products of combustion affect the shrinkage of brass; second, the application of the results obtained to commercial melting procedure; third, the study of the effect of various fluxing agents on the metal losses in the furnace. Shrinkage in the melting operation occurs either by volatilization or by oxidation of the alloying constituents. In the first case, the loss is through the stack, while in the second, it is represented as dross or skimmings. Whether or not the loss is primarily by volatilization or by oxidation will be determined by the composition of the metal and by the nature of the furnace atmospheres. In the melting of metals, in which volatilization losses predominate, a slightly oxidizing atmosphere may be used to provide protective layers which will result in a lowering of the metal shrinkage. In the melting of metals with predominating oxidizing losses, a neutral or reducing atmosphere may be used to keep shrinkage down to the minimum. The use of fluxes as a means of lowering the shrinkage of the metal must be based on the same considerations as hold for the lowering of metal shrinkage by furnace-atmosphere control. A flux showing very satisfactory results in producing a lowering of the metal shrinkage is developed. Ha (12a)

Casting & Solidification (12b)

Cooling and Solidification of Liquid Metal. *Foundry Trade Journal*, Vol. 45, Oct. 29, 1931, page 271.

A brief discussion of a mathematical investigation of the cooling and solidification of liquid metal by Carl Schwarz is given. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 18 and Feb. 1932, page MA 44. OWE (12b)

The Melting and Casting of Magnesium Alloys. Edmund B. Thews. *Canadian Chemistry & Metallurgy*. Vol. 16, Mar. 1932, pages 68, 70, 73.

The melting and casting of Mg is not as difficult as the melting and casting of Al when due consideration is paid to the following characteristic properties of Mg alloys: (1) their tendency to oxidize or to burn in contact with air or moisture, their very low specific weight, and their explosive reaction with moisture. Melting and pouring operations are outlined and fluxes discussed. The latter consist chiefly of $MgCl_2$ mixed with other chlorides or fluorides. Precautions noted are: proper facility for release of air and gases from molds, cooling rings and chill plates avoid cooling strains in heavy casting molds. Graphite pastes change the metallic character of the cooling surfaces to reduce explosive tendencies. Molds should be filled quickly. WHB (12b)

Composition of Steel Mill Molds. (Über die Zusammensetzung von Stahlwerkskokillen.) *Die Metallbörse*, Vol. 21, Oct. 18, 1931, pages 1866-1867; Oct. 24, 1931, pages 1898-1899.

Analyses of some 17 molds of American, German, English, Belgian, Austrian and French origin are given showing a great variety of composition. The effect of C, Si, Mn, S, P, Ni, Cr on wear of iron and steel molds is discussed. EF (12b)

Comparative Fluidity Tests. (Vergleichende Giessbarkeits-Versuche.) Ernst Scheuer. *Metallwirtschaft*, Vol. 10, Nov. 20, 1931, pages 884-885.

The apparatus used was similar to that developed by Guillet and Portevin, in which the metal is cast under definite conditions at constant hydrostatic pressure into a spiral shaped mold. The fluidity is measured by the length of the mold which is filled out with metal. The fluidity of Zn, Al and silumin increases proportionally with the pouring temperature. Mold temperature has little influence up to 300° C.; above that it increases the fluidity. The smoothness of the mold surface has practically no influence. The fluidity of the binary alloys Al-Si, Al-Cu, Al-Zn and Al-Ni was investigated. In each case, small additions of the respective metals lower the fluidity of pure Al. With further additions it rises again, approximately up to the eutectic point, after which it remains almost constant. Additions of Cd and Ni up to 1.5% to silumin raise its fluidity about 10%. Mg, Cu, Zn and Mn have little or no effect. Additions of Mg up to 2% to a 13% Al-Cu alloy lower the fluidity slightly, further additions raise it. The lowered fluidity is explained by the formation of a solid solution, and the increase with higher additions by the formation of a eutectic. CEM (12b)

On the Residual Strain of the Grey Iron Castings. S. Matoba & H. Kishimoto. *Kinzoku-no-Kenkyu*. Vol. 9, Feb. 1932, pages 74-84.

The gray iron castings having simple geometrical forms were made as to cool in different velocities in different parts. By measuring the elastic strain due to the initial stress remaining them, it was found that the amount of residual strain is practically proportional to the difference of mean cooling rate from the pouring temperature to a temperature at which the stress begins to be provoked, and is independent of the mode of cooling thereafter. The casting stress or the mechanism of growing the initial stress in the casting was formerly elucidated only qualitatively by Martens and Heyn. In the present work, however, the strain was quantitatively measured and further extention was made to their explanation. And it was also found that the amount of residual strain is minimized by making the temperature uniform during cooling at every part in the casting. The residual strain of gray iron casting can be eliminated by annealing as cold worked steel. The annealing is nearly complete when the casting is heated to 600° C. for 1 hour. HK (12b)

The Solidification of Steel Ingots. B. Matuschka. *Rolling Mill Journal*, Vol. 5, Oct. 1931, pages 643-646.

See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 73. Ha (12b)

Steel: The Casting of the Ingot. (L'Acier: La Coulée le Lingot). Marcel Guedras. *Aciers Spéciaux, Métaux, et Alliages*, Vol. 6, Sept. 1931, pages 463-464; Dec. 1931, pages 657-659.

A critical study about molds and ingots. The shape of molds is considered rather generally. Then the casting temperature is discussed. This temperature is greatly responsible for the formation of "ghost lines." Author recommends as the temperature for casting about 100° C. higher than the melting point of steel or alloy steel. GTM (12b)

The "Runnability" of Electric Steel (La colabilità dell acciaio elettrico). U. Gabino. *La Metallurgia Italiana*, Vol. 24, Mar. 1932, pages 187-191.

The Cury fluidity spiral has been modified so as to require less metal. The cross section of the spiral is a trapezoid 5 mm. at the bottom, 10 mm. at the top, 8 cm. high. It is 1 m. long, with 20 divisions, 5 cm. apart, gated in the center of the spiral, with a small basin below the sprue. Common dry sand, synthetic dry sand, clay bonded, and green sand with 1% dextrin all gave about the same length of spiral, while green sand without dextrin, with 4% moisture gave a much shorter spiral. Mold coatings do not notably affect the length. The normal amount of Si is necessary to obtain suitable runnability. Ordinary variations in composition do not have much effect. The temperature of the steel is the most important variable. The length of the spiral varies, by practically a straight line relationship, from 7 divisions at 1490° C. to 14 at 1550° C. The spiral has been found very helpful in steel foundry operation. HWG (12b)

The Freezing of Steel Ingots. J. Cunningham. *Metallurgia*, Vol. 5, Apr. 1932, pages 199-200.

Reviews the mathematical treatment of solidification of ingots reported by the Steel Committee of the Verein deutscher Eisenhüttenleute in the *Archiv für Eisenhüttenwesen*. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 18; Feb. 1932, page MA 44. JLG (12b)

Rolling (12c)

Roll Pass Design. Part XXVIII. W. Trinks (Carnegie Inst. of Technology). *Rolling Mill Journal*, Vol. 5, Apr. 1931, pages 261-264, 267-268.

Gives complete table of data on gothic passes employed in roughing rolls of hand mills, with a section by section analysis of a single gothic pass. These passes are usually rolled zig-zag fashion and the reductions are not very heavy. The use of diamond passes in continuous billet mills is also described. Tables of data are given on the diamond-square-diamond reduction method for the production of square sections by alternate diamond and square passes. JN(12c)

Resistance to Deformation and Flow of Metal in Rolling. Part II. Erich Siebel. *Rolling Mill Journal*, Vol. 5, Apr. 1931, pages 269-270, 296.

A report of the Rolling Mill Committee of the German Iron and Steel Institute, translated from *Stahl und Eisen*. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 270. The author furnishes a set of graphs with a short discussion showing the effect of rolling temperature on the resistance to deformation of ordinary mild steel for reductions from 10 to 50% and for thickness ratios of 11.2%, 5.6% and 2.8%. JN (12c)

New High Capacity Rolling Mills for Foreign Order. (Neue Hochleistungswalzwerke des Auslandes.) *Die Metallbörse*, Vol. 21, Sept. 12, 1931, page 1707.

Data on rolling mills recently designed in Germany for foreign order (Russia) are given referring to 5 different blooming mills. In conclusion the writer mentions an American built rolling mill of the "cross country type." EF (12c)

The Operating Organization in the Rolling Mill with Special Regard to the Program of Work. (Die Betriebsorganisation in einem Walzwerk unter besonderer Berücksichtigung der Arbeitsvorbereitung.) Kurt Wiecke. *Stahl und Eisen*, Vol. 52, Jan. 28, 1932, pages 77-84.

Report 91 of the Rolling Mill Committee, and Report 54 of the Committee on Economy of Operation of Verein deutscher Eisenhüttenleute, and presented at meeting Sept. 29, 1931. Includes 14 diagrams. A paper on economy of operation which may be obtained by preparation of an outline of the work to be done. This preparatory outline for a rolling mill may be divided into 5 main groups: (1) outline of rolling program; (2) preparation of intermediate materials; (3) preparation for operating crews; (4) preparation for rolling; (5) final working instructions. In addition, it is shown how, with help of few and simple notes, to draw up technical and cost accounting figures, which make possible careful and thorough operating supervision. By means of correct figuring of daily costs a satisfactory pre- and post-accounting is developed, which serves the operator as well as a necessary set of tools. DTR (12c)

Bearings in Rolling Mill Housings. C. Rademacher. *Domez* (Achievements of Metallurgy in USSR and Abroad), No. 10, 1931, pages 38-46.

Mechanical details and principles involved in the service of bearings for roll necks are described. (12c)

Design Principles for Mill Tables. A. B. De Salardi. *Rolling Mill Journal*, Vol. 5, Aug. 1931, pages 547-550; Oct. 1931, pages 661-662, 674; Dec. 1931, pages 779-782, 791-792.

Formulas for the calculation of the individual parts of mill tables and the necessary driving power are developed. Formulas for the design of gears and bearing parts are derived from the torque-effect of the impact between bar and roller. Ha (12c)

Developments in Steel Mill Drives. John Liston. (General Electric Co.). *Rolling Mill Journal*, Vol. 6, Jan. 1932, pages 13-14, 30.

Excerpt from General Electric Review, Jan. 1932. Describes several drives which were built and installed during 1931. MS (12c)

Metal Lubrication and Roll Cooling in Aluminum Hot-Mill Practice. Robert J. Anderson. *Iron Age*, Vol. 128, Dec. 31, 1931, pages 1674-1677.

Lubrication of ingot surface is necessary to prevent slabs from sticking to the rolls, to increase tendency of rolls to bite and to prevent slabs from curling. Various lubricants have been used, such as kerosene, light machine oil, transformer oil, cup grease and water oil mixtures. Discusses the relative merits of these and the practice of some American and European plants. VSP (12c)

Electrical Developments in Rolling Mills for 1932. C. P. Croco. (Westinghouse Electric & Mfg. Co.). *Rolling Mill Journal*, Vol. 6, Jan. 1932, pages 11-13.

Outlines developments in the application of electrical drives to rolling mill equipment and describes briefly several installations. MS (12c)

The Manufacture of Seamless Tubes. Wm. H. Engelbertz. *Rolling Mill Journal*, Vol. 5, Apr. 1931, pages 243-246.

A description of the Pilger or Mannesmann Mill process, the semi-automatic process, and the push bench process for the production of seamless steel tubes with a discussion of output capacities of each process per 8 hr. shift. JN (12c)

The Composition of Modern Roll Metals. Part II. John Hruska. *Rolling Mill Journal*, Vol. 5, Apr. 1931, pages 265-267.

The author gives the analytical composition of chilled and unchilled high-carbon steels used in the manufacture of rolls for high-speed rod mills, with scleroscopic determinations on the former. He also gives the analysis of rolls made of pearlitic manganese steel and of high-chromium steel used in cold rolling. He discusses the special advantages of rolls made from Mo alloy steels and the heat treatment required for rolls containing Mo, Ni and Cr. JN (12c)

Sheet and Tinplate Rolls: An Investigation into the Roll Loads, Stresses, and the Causes of Roll Breakage. J. Selwyn Caswell. *Proceedings, South Wales Institute of Engineers*, Vol. 46, Jan. 14, 1931, pages 813-834; Vol. 47, Apr. 10, 1931, pages 109-140; Vol. 47, Sept. 15, 1931, pages 367-373.

Discussion of article abstracted in *Metals & Alloys*, Vol. 2, Jan. 1931, page 11. AHE (12c)

Sheet and Tinplate Rolls. J. Selwyn Caswell. *Blast Furnace & Steel Plant*, Vol. 19, Nov. 1931, page 1490; Dec. 1931, page 1592.

Parts of a serial abstract published in Proceedings South Wales Institution of Engineers, Vol. 46, pages 312-452. See *Metals & Alloys*, Vol. 2, Jan. 1931, page 11. MS (12c)

Inclusions—Their Effect, Solubility and Control in Cast Steel. C. E. Sims & G. A. Lillieqvist (American Steel Foundries.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 453, Feb. 1932, 24 pages.

From an extended series of observations it was found that there was a direct relationship between the distribution of inclusions in steel castings and the ductility of the steel. Globular inclusions with a random distribution had a minimum effect on the ductility, while inclusions in a net-work decreased the ductility. In the latter type of distribution the inclusions were probably formed after part of the steel had solidified, and they appear to be part of a eutectic. The net-work distribution was found most frequently in steels that had been deoxidized with Al. As far as could be determined the ductility was independent of the quantity of inclusions. The average size of inclusion was dependent on the size of the casting, increasing with increasing size of casting. It was apparent that the inclusions were soluble in the molten steel. A high FeO content was found to favor the formation of the globular type of inclusion, and thereby a high ductility. This is due to the fact that if the FeO content is low the solubility of the sulphides in the molten steel is increased and they do not separate until the last of the steel solidifies. It is concluded that it is impossible to remove inclusions or to prevent their formation by simple methods because they are soluble in the molten steel. Adding a small amount of Fe ore just before the deoxidizers served to insure the production of ductile castings. 7 references. JLG (13)

The Formation of Draws and Porosity in Castings. (Über die Lunker-und Porenbildung in Gussstücken.) E. Scheuer. *Metallwirtschaft,* Vol. 10, Dec. 18, 1931, pages 947-951.

Contains 5 references. Porosity in castings is due either to shrinkage of the metal during solidification or to the release of dissolved gases in the melt. The two causes are closely related and it is sometimes impossible to determine which of the two is the cause of porosity in a casting. The formation of finely divided shrinkage pores is reduced by a large temperature drop during solidification, by the use of alloys with a small solidification range and small difference in concentration between liquidus and solidus, and by the use of alloys with a small or sufficiently large percentage of eutectic. Most metals dissolve more gases the higher the temperature they are heated to, so that overheating is to be avoided. If the dissolved gases have a chance to escape before the metal solidifies no harm will result, but if the surface solidifies too quickly, gas will be entrapped and gas pockets form. Single large porous places have a greater weakening effect on the casting than a large number of small porous spots, especially if the large hole is in a vital section. Besides weakening the casting porosity may cause leakage in pressure tight castings. A number of casting defects are illustrated. CEM (13)

Hair Cracks on the Surface of Sheets. Erich A. Matejka *Blast Furnace & Steel Plant,* Vol. 19, Nov. 1931, pages 1467-1470, 1472; Dec. 1931, pages 1555-1559.

Includes 21 references. Part of a serial translation from *Archiv für Eisenhüttenwesen.* See *Metals & Alloys,* Vol. 1, Aug. 1929, page 78. MS (13)

Inclusions Cause Majority of Valve Spring Wire Failures. Frank Stones (Eaton Spring Corp.). *Iron Age,* Vol. 128, Nov. 12, 1931, pages 1234-1237.

In correctly heat treated springs which have not been over-stressed, failures are due to the presence of non-metallic inclusions located near some highly stressed area. According to Gillett and Mack, inclusions some distance away from the point of maximum stress need not necessarily cause failure. The 5 principal impurities in commercial steel are sulphides of Fe and Mn, silicates of Fe and Mn and oxide of Fe. 99% of hardened and tempered valve spring wire in use is badly laminated. Ghost lines are associated with inclusions; they are the result of heterogeneity not only of P, but also of S, although it is uncertain whether inclusions are incidental or their direct cause. Surface decarburization is important to the life of springs. The importance for a greater portion of tested material to reduce the risk of breakage is emphasized. A German machine tests 96 valve springs at once. VSP (13)

Oil Well Valves Use High Carbon Stainless Balls. H. T Morton & I. A. Rummler (Hoover Steel Ball Co.). *Metal Progress,* Vol. 21, Jan. 1932, pages 27-31.

Discussion of the effects of mill defects such as seams, hairlines, and the like on localized corrosion and mechanical failure of check valve balls in oil lines. High carbon (1.0 to 1.1%) stainless (Cr 17.0 to 17.5%) steel is used. WLC (13)

Inverse Segregation. *Metallurgist,* Dec. 1931, pages 178-179.

The phenomenon sometimes known as "liquation" but more correctly called "inverse segregation" is described as follows: when an alloy which has a long range of solidification, either as a solid solution or by the formation of eutectic, solidifies, the crystals first formed have the lowest content of alloying elements, with the result that, as solidification proceeds the residual liquid becomes richer and richer in alloyed metals. If this were the whole story the outer parts of the ingot or casting would contain the least of the alloying elements. The reverse is true, ingots sometimes having a much higher content of alloying elements in the outer part than the average content of the entire ingot. Consideration must be given the fact that the mass of crystals and liquid are in constant motion thus upsetting equilibrium conditions. The explanations offered have included the "Soret Effect," which is an attempted equilibrium between two differing concentrations of elements due to a steep temperature gradient in the same liquid or mass, and the presence of gas in the liquid metal forcing liquid metal from the interior to the outside through the interstices remaining between the crystals of the solidified outer zone. VVK (13)

Non-Metallic Inclusions in Steel. J. C. Booth. *Chemical Age,* London, Vol. 26, Metallurgical Section, Jan. 2, 1932, page 1.

A brief review. VVK (13)

Manual of Industrial Chemistry. Vol. 1, Inorganic; Vol. 2, Organic. Edited by Allen Rogers. 5th edition. D. van Nostrand, New York, 1931. Fabricoid, 6 x 9 inches, 1517 pages. Price $13.00.

Rapid changes and advancements in the field of industrial chemistry since the last edition appeared in 1925 have necessitated a new edition of Rogers' *Industrial Chemistry.* Chemists are so familiar with this work that little need be said in introducing it. For students and younger chemists, who may not be acquainted with this standard textbook and manual, it may be stated that each chapter covers a given industry or process, and the various chapters have been written by men who are recognized as authorities in their respective lines. Dr. Rogers states in the preface, "The aim of the authors is not to give undue attention to minor details, but to stress fundamental principles so that the student may get a background knowledge of the subject. The subject matter is essentially descriptive, without, however, omitting the theoretical considerations necessary for a proper understanding of the subject."

The fifth edition in general covers the same field as the fourth edition, but most of the chapters have been revised to bring the subject matter up to date. In many chapters production data and other statistics have been revised. The fifth edition contains 52 chapters and has been written by Dr. Rogers and 41 collaborators. With few exceptions the chapters have been written by the same experts who were responsible for the fourth edition. The chapter on *Water for Industrial Use,* formerly by Herman Stabler and Alfred A. Chambers, is now written by D. D. Jackson and W. D. Turner, both of the Department of Chemical Engineering, Columbia University. *Organic Chemicals and Intermediates,* formerly by Dr. Rogers, has been greatly enlarged by Alexander Lowy, Professor of Organic Chemistry, University of Pittsburgh, and is now titled *Industrial Organic Chemicals and Dye Intermediates. Petroleum Industry,* formerly written by Thos. T. Gray, is now by Gustav Egloff, Universal Oil Products Company. *Soap and Soap Powder* of the fourth edition, by Lincoln Burrows, appears in the fifth edition as *Soap and Soap Products,* by Martin H. Ittner, Colgate-Palmolive-Peet Company. *Resins, Gums, Turpentine, and Shellac,* revised by Dr. Rogers in the fourth edition, now appears under the same authorship as *Resins, Gums, and Turpentine,* while a new chapter, *Shellac,* has been written by A. C. Langmuir. *Sugar,* written by the late G. L. Spencer in the fourth edition, is revised in the fifth edition by Claude S. Hudson, Professor of Chemistry, Hygienic Laboratory, Washington, D. C. *Cellulose Industries,* formerly by Jasper E. Crane, is now written by Gustavus J. Esselen, Consulting Chemist, Boston. The chapter on *Zinc Oxide and Lithopone* has been extended to include white zinc pigments.

In addition to the new chapter on shellac mentioned above several others have been added. *Soda and Allied Industries* and *Electrolytic Caustic and Bleach Industries* have been written by T. P. Hou, Pacific Alkali Works, Tangku, Hopei, China. A new 51-page chapter, *Industrial Instruments and Their Uses* has been prepared by M. F. Behar, Engineering Editor of Instruments. A Chapter, *Solvents and Nitro Cellulose Lacquers,* has been written by D. B. Keyes. The Chapter, *Brewing and Malting, Wine, and Distilled Liquors,* which appeared in earlier editions was deleted from the fourth edition, but again finds its way back into the fifth. The editor states that the material was eliminated from the fourth edition owing to the Eighteenth Amendment of the Constitution, but that demand for a technical treatment of the subject has been so great that a condensed review of the material has been compiled. The editor states that he has attempted "to present the subject from a technical standpoint only, and in no sense as an aid to home fabrication." The chapter, *Dehydrated, Dried and Evaporated Foods, Condensed Foods,* has been omitted from the fifth edition.

In the preface the editor calls for constructive criticisms. Many chapters could be improved by adding footnote references or bibliographies at the end of sections. Of the 52 chapters, 14 contain neither footnote references nor bibliographies and fully half a dozen more contain only 1 or 2 footnotes. It would also be valuable if costs could be stressed more than they are in some chapters.

The paragraph on "concentration," page 10, needs complete revision. The following statements do not correctly describe the processes involved: "In a jig advantage is taken of the principle of Archimedes which states that the rate of fall of fragmental solids through liquids and gases is proportional to their specific gravity and size. When the particles have the same specific gravity the Wilfley table is employed in which cross or back washing is carried out. Flotation takes advantage of the affinity of certain substances for oils, greases and gases, and the repulsive effect of the same substances on the tension of a water surface."

The chapter on *General Processes* has not been so well brought up to date as some other chapters. A notable omission under "grinding" is the Symons cone crusher. The author includes all types of crushing and grinding under the general heading, "grinding." The usual classification of most authorities consists of: breaking or coarse crushing, intermediate or secondary crushing, and fine grinding.

On page 711 the equilibrium values given for the producer gas reaction are those of Clement and Adams. These old values are not accepted by present day physical chemists who are working on the equilibrium of systems involving CO and CO_2. The most generally accepted values are those of the Rhead and Wheeler second series and of Jellinek and Diethelm.

On page 219, in discussing the use of ferric sulphate, no mention is made of the employment of this reagent as a solvent for certain sulphide ores of copper.

A number of errors in proof reading found in the fifth edition were also present in the fourth and have not been corrected, but few of these are serious except one on page 791, where $C + CO_2 = 2CO \pm 38.85$ calories should be — 38.85.

Rogers' "Industrial Chemistry" has long been a reference book in every chemical library. The present edition is even better than former ones and should continue to receive its well-deserved popularity. John D. Sullivan (14)-B-

Steel and Alloys. Robert Hadfield. *Times,* London, Faraday Number, Sept. 21, 1931, page 11.

The author notes that beside all his other physical and chemical works and discoveries, Michael Faraday had done quite extensive and systematic work in metallurgy. In a box were found 79 specimens of steel and alloyed steel which, upon investigation, proved to be alloys of steel with 16 different elements. Among others was one containing 50% Pt; one with 80% Pt; another with 50% of rhodium; others with Ni, Cu, and Cr. It can be said justly that Faraday was also a pioneer in this field of metallurgy. Ha (15)

The Chemical Composition of Prehistoric Bronzes. (Zur chemischen Zusammensetzung der vorhistorischen Bronzen.) John Sebelien. *Chemiker-Zeitung,* Vol. 55, Dec. 19, 1931, pages 973-974.

Analysis was made of 29 objects of Egyptian origin. Up to about 4000 B.C. fairly pure Cu was used. Bronzes are found from about 1200 B.C. on. The objects contained from 57 to 100% Cu, with Fe, Zn, As, Sn, Ag, Bi, Ni and sand as impurities. CEM (15)

Salt Cellars—Old and New. Part 2—Salts from the 18th Century to the Present Time. A. F. Saunders. *Metal Industry,* N. Y., Vol. 30, Feb. 1932, pages 57-58.

Descriptions and illustrations of salt cellars are given. PRK (15)

History of the Wire Industry. K. B. Lewis. *Wire & Wire Products,* Vol. 6, Dec. 1931, pages 465-469, 484-485; Vol. 7, Jan. 1932, pages 9-11, 29.

An historical sketch of wire drawing is given from the crude beginnings in 1000-1400 A.D., when the iron was melted directly from the ore in small charcoal fires and recovered in crude lumps mixed with slag and dirt. The iron was hammered into bars and then drawn. Between 1500 and 1600, speed hammers became available. This was the beginning of the modern industry. Dies are about 100 yrs. old. Coating, enameling and drafting practices are described. There are some interesting old photographs. The historical development of rod production of hammering and slitting mill from about 1600 to the present day is described; future possibilities are discussed. Ha (15)

Platinum as a Factor in the World's History. (Platin als weltgeschichtlicher Faktor). W. Ostwald & E. Brauer. *Siebert Festschrift,* 1931, pages 240-256.

General discussion of oxidation of NH_3 to HNO_3 by a Pt catalyst, with photographs of commercial installations. HWG (15)

Faraday and His Metallurgical Researches. Robert A. Hadfield. Chapman & Hall, London, 1931. Cloth, 6½ x 10 inches, 329 pages. Price 21s.

The first 136 pages are historical, dealing with Faraday and his contemporaries. The next 105 pages describe in great detail the examination of 79 specimens of steel and alloy steel made by Faraday in the Royal Institution in 1819-1824. The steels were melted in crucibles in a bellows-blown, forced-draft coke furnace and allowed to freeze in the crucible. The alloying elements mostly used were of the platinum group, those metals being at that time more readily available than the modern alloying elements. The samples were small. All were found packed in a 9" x 5½" x 5½" box bearing labels in Faraday's writing. Chemical analysis, microscopic examination and a few determinations of magnetic properties, hardness, critical points, behavior under corrosion, etc. were made. Two tests were made on tiny tensile specimens, one of 0.94% C, 0.74% Pt, and one of 0.92% C, 1.20% Rh, forged from Faraday's samples and normalized. (Faraday's steels contained only traces of manganese.) The results indicate a very slight strengthening effect of Pt and Rh over a plain carbon steel of low manganese. Dilatometer curves are shown for these two steels. Critical point curves are shown for steels of 1.06% C, 2.18% Ni, 0.75% Au and 0.94% C, 0.74% Pt. Some samples of steel containing Ag indicate that the solubility of Ag in high carbon steel is low. Faraday had made this statement on the basis of visual examination. The samples of steel with Au are structurally similar to carbon steel and Au up to 0.90% appears to be soluble and not to affect the eutectoid ratio.

Steels of 1.09% C, 0.53% Cr.; 1.59% C, 2.36% Cr; 0.94% C, 0.75% Ni; 0.65% C, 2.19% Ni; 1.30% C, 1.50% Cu; 1.05% C, 2.79% Cu, four with Ag, three with Rh, 17 with Pt and three with Pt and Ag, Au and Ag and Ni and Au were found among. A tiny knife of usable quality was made of the 0.94% C, 0.74% Pt steel, and a small razor from one of 0.94% C, 0.69% Pt. A razor was also examined which was given by Faraday to a friend, which was found to contain 1.10% Pt. These razors would shave, but were not superior in performance. Evidence is submitted indicating that, on the basis of Faraday's tests, a steel containing silver was used commercially for a few years by a firm in Sheffield, which thought the alloy steel to be better than the carbon steel it had been using.

A few other samples of alloys made by Faraday, with as low as 0.07% C and up to nearly 50% Pt or Rh and one with about 23% Pd, were examined. The high Rh alloy appears to have some value as an acid-resistant alloy. The experimental difficulties Faraday had in making alloy steels 110 years ago were very great, and the lack of methods of quantitatively evaluating the properties prevented Faraday from finding out the real effect of the alloying elements used. Although this work of Faraday is the first attempt to make alloy steels on record, it is doubtful if any other experimenter has made up as many Pt and Rh steels.

The balance of the book is made up of comments on later developments on alloy steels, especially those studied by Hadfield or produced by his firm. Although Faraday's name is primarily connected with electricity, he was a pioneer in metallurgy. Sir Robert Hadfield's study of Faraday's samples and his account of Faraday himself are of historical interest, and it is evident that Sir Robert found his task a delightful one. H. W. Gillett (15)-B-

Silver in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 2.

Ag price in 1931 was the lowest on record. World production is estimated at about 196 million ozs. (52 million less than 1930). U. S. production (30,967,618 ozs.) was roughly ½ the average of the past 20 years. Canadian production was 23% less (20,403,771 ozs.). AHE (16)

British Columbia in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 19.

The estimated return from mines in British Columbia in 1931 is $36,000,000 as compared with $55,500,000 in 1930. AHE (16)

Gold, Silver, Copper, Lead and Zinc in Colorado in 1929. Chas. W. Henderson. *Mineral Resources of the United States,* 1929, *United States Bureau of Mines,* Part 1, Oct. 31, 1931, pages 921-968.

The total gross value of Au, Ag, Cu, Pb and Zn recovered in Colorado in 1929 decreased 7% from 1928; Au decreased 17%, Ag 1%, Pb 1%, Zn 11%, while Cu increased 27% in value. Production was Au $4,417,358; Ag 4,397,377 oz., $2,343,802; Cu 8,905,074 lb., $1,567,293; Pb 48,889,906 lb., $3,080,064; and Zn 58,861,000 lb., $3,884,876. AHE (16)

The Basic Bessemer Process: Some Considerations of Its Possibilities in England. Vernon Harbord. *Engineering,* Vol. 131, May 22, 1931, pages 683-684; discussion, May 22, 1931, pages 679-680.

Condensed from paper read before the Iron and Steel Institute, London, May 8, 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 275. LFM (16)

Economies and Efficiencies in Mine and Plant. A. H. Hubbell. *Engineering & Mining Journal,* Vol. 133, Jan. 1932, pages 5-9.

A general review of directions in which savings and improvements may be effected is accompanied by a chart showing the technical interrelation of the metal and non-metal industries through common production and extraction processes and several tables. WHB (16)

The Lead Situation. H. G. Crane (St. Joseph Lead Co.). *Mining Congress Journal,* Vol. 17, Nov. 1931, pages 592-593, 596.

The United States has adhered to high production schedule with natural result of rapidly decreasing market price for lead. The daily world production of lead for each country is shown for the same months in 1929 and 1931, with percent increase or decrease. Graph of total refined lead production from domestic mines and secondary lead production is given in short tons for years 1885 to 1930. The per capita consumption of lead has increased greatly since 1913, 8.75 lbs. per capita, compared with 12.05 lbs. per capita in 1929. With regard to tariff protection, over-production in the U. S. has prevented the domestic lead miner from getting the full benefit of the tariff, as domestic price has been forced to within a short distance of the London price level. Virgin lead situation is complicated by growing importance of secondary or scrap lead. The smelting and refining of secondary lead is now an integral operation of nearly all primary lead producers. DTR (16)

New Method Cuts Cost of Handling Sheet Steel. C. B. Crockett. *Steel,* Vol. 89, Oct. 5, 1931, pages 31-32.

By the installation of a synchronized system using two types of mobile equipment the cost of handling sheets, including method of packing, storage space required, appearance of plant, injury to workmen, etc., was reduced by 85%. Ha (16)

Power Rate Influences Electrical Equipment and Melting Cost. O. H. Henschel. *Foundry,* Vol. 59, June 1, 1931, pages 57-59.

A proper study of the power rates available to the foundry may lead to considerable saving in the energy bill. An example for 3 different rates for the same consumer illustrates the manner in which the whole layout, substation and auxiliary, as well as operation can be influenced by the rate at which energy is purchased. Ha (16)

Establishing a Furnace-Hour Rate for a Brass Casting Shop. Waldo Hutchinson. *Canadian Foundryman,* Vol. 22, Sept. 1931, pages 10-13.

A complete discussion of the methods adopted in establishing a furnace-hour rate for a brass casting shop, in which special methods of casting are dealt with in some detail. OWE (16)

The Situation of German Iron Foundries in 1931. Th. Geilenkirchen. *Foundry Trade Journal,* Vol. 46, Jan. 21, 1932, pages 53-54.

A discussion of the economic situation in Germany during 1931 in so far as it affected the iron foundries of that country. OWE (16)

Economics of the Minnesota Iron Mining Industry. E. W. Davis. *Civil Engineering,* Vol. 1, Dec. 1931, pages 1349-1351.

Data secured from the Tax Commission show that there is in Minnesota sufficient iron ore to last about 35 years. This value is placed on material classed as high-grade ore. In addition to this high-grade ore the state contains immense quantities of low-grade ore not now being used, which pays little or no tax because it has no commercial value. It is estimated that this low-grade if utilized would last for several hundred years. The total tax on ore is about $0.50/ton of ore shipped. Of this, the ad valorem tax amounts to $0.39/ton, and the occupation and royalty taxes together amount to $0.11/ton. The occupation and royalty taxes are paid on tons of ore shipped, and if no ore is shipped no taxes are paid. The ad valorem tax is a property tax and decreases as the value decreases. The mining companies, therefore, mine and ship the ore as rapidly as possible and surrender the lease as soon as the available high-grade ore is gone. The present system of taxation does not, therefore, stimulate the utilization of the low-grade ore. The result is that when the high-grade is exhausted the mining companies turn to foreign countries for their high-grade ore. It has not yet been demonstrated that the low-grade material can be economically converted into merchantable ore. Minnesota should therefore assume a liberal attitude toward the low-grade ore industry and do everything in its power in the very near future to assist the mining companies in demonstrating the commercial value of these low-grade materials. WAT (16)

FOUNDRY PRACTICE & APPLIANCES (22)

The Casting of Threads. W. Schäfer. *Foundry Trade Journal,* Vol. 46, Mar. 17, 1932, page 172.
An article translated from *Die Giesserei* and accompanied by 3 diagrams. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 50. OWE (22)

Effect of Heat on the Permeability of Sea Coal Facing Sands and Core Sand Mixtures. Walter M. Saunders & Walter M. Saunders, Jr. *Transactions & Bulletin American Foundrymen's Association,* Vol. 2, Oct. 1931, pages 440-448.
On heating test cores of molding sand and sea coal mixtures, and also core sand with binders, the permeability decreases considerably. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. CHL (22)

Nickel Affects Strength of Bronze Foundry Mixtures. N. B. Pilling & T. E. Kihlgren. *Foundry,* Vol. 59, Nov. 1, 1931, pages 54-58.
Abstract of a paper read before the American Foundrymen's Association in Chicago. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 25. VSP (22)

Deep Etching of Brass Applied to Gating Problems. R. W. Parsons. *Transactions & Bulletin American Foundrymen's Association.* Vol. 3, Feb. 1932, pages 843-856.
Deep etching was applied to determine the best method for gating castings. There is a relationship between length of bar and diameter to obtain sound castings. Pouring temperature was shown to have a definite relation to the physical properties of the castings. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. CHL (22)

The Relationship between the Engineering and the Foundry Trades. L. G. Pomeroy. *Engineering,* Vol. 132, July 3, 1931, page 10.
Abstract of a paper read before the Institute of British Foundrymen, June 1931. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 280. LFM (22)

Bath Tub Molding with Only One Jolter. (Badewannenformerei mit nur einem Rüttler.) U. Lohse. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Jan. 16, 1932, pages 55-56.
The general considerations for quantity production in foundries are discussed and a method of molding bath tubs is described where only one jolter is required; the described plant has automatic equipment for the preparation of the molding sand. Ha (22)

Recent Developments in Cast Iron and Foundry Practice in Great Britain. J. G. Pearce. *Engineering,* Vol. 132, July 3, 1931, pages 9-10.
Abstract of a paper read before the Institute of British Foundrymen, June 1931. See *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 107. LFM (22)

Some Jobbing Foundry Molding Jobs. J. H. List. *Foundry Trade Journal,* Vol. 46, Feb. 4, 1932, page 87.
A description of 3 jobs—(1) an ejector water heater cast in a zinc-free alloy, (2) a small cast-iron vase pedestal, and (3) a small grease trap. The article is accompanied by 2 photographs showing the mold and cores used in the production of the water heater, and 2 diagrams showing the arrangement of the mold for the vase pedestal and grease trap. OWE (22)

The Influence of the Condition of the Wall of the Mold on the Formation and Amount of the Graphite Content in Gray Iron. (Ueber den Einfluss der Formwandbeschaffenheit auf die Ausbildungsform und Menge des Graphitgehalts im Grauguss.) H. Nipper & E. Piwowarsky. *Die Giesserei,* Vol. 19, Jan. 8, 1932, pages 1-3.
Metallographically as well as chemically no difference was found for wall thicknesses of the casting up to 185 mm. The walls of the molds were coated with graphite, coke dust, soot, fire clay and coarse sand. Ha (22)

New Cupola Melting Methods. (Neue Kupolofen-Schmelzverfahren.) R. Stotz. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Jan. 24, 1932, pages 42-44; Feb. 7, 1932, pages 58-59.
The article deals in particular with the production of malleable castings and shows that many improvements can be attained by a careful supervision of the whole melting process. These improvements are shown in decrease fluctuations in composition of the malleable castings, and in more uniform mechanical properties. In comparing the C and Mn contents of malleable castings for the years 1926 and 1931 it is shown that, according to the use of the casting, the C content decreased from 3.6-3.2% to 3.2-2.6% whereas the Mn content increased from about 0.1% to 0.3%-0.5%. The steel scrap content in the charge of the cupola has also been increased. Whereas 10-15% steel scrap was common for malleable casting charges 10 years ago, this amount has been increased now to 20-25%, in some cases even up to 30%. There are no objections to such high contents of scrap in the charge. The loss of metal through oxidation is not higher with increasing amount of scrap. GN (22)

Molding and Casting a 32-ton Foundation Block. G. E. Morgan. *Foundry Trade Journal,* Vol. 46, Jan. 21, 1932, pages 55-56; Feb. 4, 1932, pages 83-85.
An article accompanied by 21 diagrams, in which a description is given of the methods used in the foundry of the East Indian State Railways for molding a 32-ton foundation block for a steam hammer. Attention is given to the raw materials used as well as to the general method of preparing the pit, constructing the mold and pouring the casting. OWE (22)

Sand Testing in the Foundry. Wm. Y. Buchanan. *Foundry Trade Journal,* Vol. 46, Feb. 11, 1932, pages 97-100; Feb. 18, 1932, pages 113-116, 124.
Paper read before the Scottish Branch of the Institute of British Foundrymen, dealing with the standard British Cast Iron Research Association compression strength and permeability apparatus and, in particular, with experiments on the effect of milling on the compression strength and permeability of sand. Some attention is directed to the effect of loading rate upon results of compression tests, and a comparison is made between results obtained with hand-rammed and compression-made cores. The effects of moisture content on the properties of sand are dealt with in some detail, as is also the influence of varying the proportions of new sand to facing sand. The article is accompanied by 4 tables and 29 diagrams. OWE (22)

Electric Furnaces. *Electrician*, Vol. 108, Jan. 22, 1932, page 106; *Foundry Trade Journal*, Vol. 46, Feb. 4, 1932, page 81.

A brief description is given of electric furnaces erected at the works of the Northern Aluminium Co., Ltd., Banbury. They contain 2 of the largest resistance units for heat treatment in England. OWE + WHB (23)

High-Frequency Induction Furnaces. *World Power*, Vol. 27, Feb. 1932, page 118; *Foundry Trade Journal*, Vol. 46, Feb. 11, 1932, page 104.

The Witton 6-cwt. high-frequency induction furnace (Stobie patent) is partially cored. The path of the magnetic field is mainly through thin laminations of high-Si low-C steel, which is brought to a central position inside the induction coil. Instead of a magnetic field weakened by air resistance (as in earlier furnaces) and uncontrolled as regards its distribution within the crucible, the electromagnetic system is so strong and centrally situated in the crucible that it has been possible to make the remainder of the electrical equipment entirely subservient to considerations of safety and efficiency (both electrically and metallurgically). OWE + WAT (23)

Some Electric Furnace Developments in 1931. C. L. Ipsen. *Wire & Wire Products*. Vol. 7, Mar. 1932, pages 78-79.

A condensed description is given of improvements in electric furnaces for annealing coil strip, sheet annealing and for Cu brazing as developed by the General Electric Co. Ha (23)

Modern Developments in Pulverized Coal Firing. R. Jackson (Alfred Herbert, Ltd.). *Transactions Tokyo Sectional Meeting, World Power Conference*, 1929, Vol. 3, 1931, pages 747-770.

A general description, including metallurgical furnaces. AHE (23)

Pulverized Fuel: Its Application to the Metallurgical Industries. R. Jackson. *Metal Industry*, London, Vol. 39, Dec. 25, 1931, pages 605-608.

From a paper read before The Co-Ordinated Societies, Birmingham, Dec. 10, 1931. The advantages and costs of pulverized fuel for Cu and Sn smelting are given. PRK (23)

A Study of the Carbonization Temperature of Coal and the Time Required. Taizo Kuroda & Kojiro Takei. *Fuel in Science & Practice*, Vol. 11, Feb. 1932, pages 56-60; *Proceedings World Engineering Congress, Tokyo*, 1929, Vol. 32, 1931, pages 207-221.

Higher carbonization temperature does not always produce the harder coke. The relation between the temperature of carbonization and the time required must be ascertained and correlated with the quality of the resulting coke. DTR (23)

Dimensions, Load, Regulation and Consumption of Electrodes in Electric Arc Furnaces for Melting of Gray Iron and Steel (Ausmasse, Belastung, Regelung und Verbrauch der Elektroden der Lichtbogenöfen zum Schmelzen von Grauguss und Stahl). E. Kothny. *Giesserei mit Giesserei-Zeitung*, Vol. 18, Nov. 13, 1931, pages 873-879.

A complete tabulation of the distribution of furnaces with electric arc in different countries is given and all the above-mentioned details are compiled. Ha (23)

The Behavior of Solid Fuels During Oxidation. Burrows Moore. *Fuel*, Vol. 10, July 1931, pages 293-296, Aug. 1931, pages 344-349; Sept. 1931, pages 394-400.

Part V. Increasing the O temperature (1) causes increased rate of combustion and heat evolution during the pre-ignition period, which rate in the case of cokes decreased soon after ignition and remained practically uniform for a considerable period during which the rate of heat produced by the oxidizing fuel was nearly equal to the rate of heat loss from the fuel; (2) does not increase the mean or maximum temperature attained by the combustion; (3) tends to ensure more complete combustion in the case of fuel charges which are not widely dispersed as fine particles in the O or air used for combustion; (4) does not affect greatly the rate of heat loss from the fuel during the combustion and, therefore, the considerable difference between O temperatures which may exist when the ignition and combustion characteristics of fuels with considerably different glow-point temperatures are compared do not introduce serious errors in estimates of ignition factors and combustible capacities by the method employed; (5) does not greatly increase the combustible capacity of the fuel. There is no advantage, in processes using powdered fuel for firing purposes, in increasing the O or air temperature above the ignition temperature. Part VI. Exposure of bituminous coal for several hours at normal atmospheric temperature and at a pressure of 650 mm. of Hg to air containing a high proportion of (a) O and (b) N causes no marked change in the ignition and combustion characteristics of the coal. Similar exposure to air containing a high proportion of CO_2 leads to increased reactivity of the coal to O; the apparent increase of reactivity probably is related to the displacement by the CO_2 of occluded gases from the fuel. The absorption by coal, at normal temperature and pressures less than 650 mm. of Hg, of O and N appears to be chiefly of a physical nature. Normal "constitutional" moisture is not objectionable in connection with the ignition and combustion properties of coal but moisture considerably in excess of the normal content raises the relative ignition temperature, reduces the combustible capacity and decreases temporarily the tendency for spontaneous ignition to occur. Part VII. The spontaneous ignition tendencies of coals have been investigated by the relation between (1) the O temperature, and (2) the time of the occurrence of (a) glowing of the coal and (b) ignition of the volatile matter and by the comparison of the ignition factors of the coals. Results indicated that the tendencies for ignition of the volatile matter to occur were greatest with coals from seams associated with fires in the mine, and the highest ignition factors were obtained from these coals. The results provide evidence that the method could be employed to assist in identifying seams or parts of seams particularly liable to spontaneous ignition, and to differentiate coals according to their tendencies to spontaneous ignition. WAT (23)

Linear Expansion of Common and Black Silica Bricks on Heating. P. P. Budnikoff & V. Mueller. *Domez* (Achievements of Metallurgy in USSR and Abroad), No. 10, 1931, pages 24-28; *Berichte der deutschen keramischen Gesellschaft*, Vol. 13, Jan. 1932, pages 28-31.

Black grade of silica brick was made by adding to the mix some blast furnace dust until the finished brick contained about 5% of Fe_2O_3. The expansion of common (94.72 SiO_2, 1.91 Fe_2O_3, 2.29 CaO) and black (91.08 SiO_2, 5.26 Fe_2O_3, 2.37 CaO) silica brick was almost the same to 900° C. Closer study of the expansion curves shows that trydimite content is higher in common bricks than in black and that the latter retains a larger amount of the original quartz. Quartz transformation is somewhat slower in black brick which is about 30% stronger. GN (24)

Zirconium Oxide, Its Production and Utilization. (Ueber das Zirkonoxyd, seine Herstellung und Verwendung.) H. Trapp. *Die Metallbörse*, Vol. 21, Aug. 12, 1931, pages 1516-1517; Aug. 19, 1931, page 1565.

Reviews the properties of zirconium oxide, its commercial application and natural occurrence. The largest part of the paper pertains to a detailed outline of the various chemical methods of preparing ZrO_2. EF (24)

Investigations into the Scorification of Refractory Materials. V. The Relation of Flux Content and Porosity to the Scorification of Fire Brick. (Untersuchungen über die Verschlackung feuerfester Stoffe. V. Der Einfluss von Flussmitteln und Porosität auf die Verschlackung feuerfester Stoffe.) H. Salmang & O. Heberstreit (Technische Hochschule Aachen). *Feuerfest-Ofenbau*, Vol. 8, Jan. 1931, pages 1-8.

Scorification tests on mixtures of 1 Al_2O_3 and 2 SiO_2 in a highly pure state and with low additions of fluxes, mainly Fe_2O_3, CaO, TiO_2, Na_2O, molded into cupels are reported. Due to the great porosity of the cupels, no differences were noticed regarding the depth of penetration of 8 different synthetic slags regardless of the flux. Another set of experiments refers to crucibles of burnt and unburnt kaolin (Zettlitz) containing various amounts of fluxes. TiO_2, Fe_2O_3 and CaO led to the most pronounced scorification if they are present exclusively in either the slag or crucible material. If the fluxes are present in both slag and crucible, the samples are less corroded. The low corroding rate of Na_2O is stressed. In a further set of experiments, blast furnace slag rich in CaO and open hearth slag rich in FeO were employed. The scorification did not prove to be proportional to the porosity of the 36 refractories tested. Only in case of the very same testing material, the slag attack increases with rising degrees of porosity. The micro-structure of refractories is of importance as to whether or not the individual pores are separated from each other or connected by minute capillaries. Hence refractories of the same chemical composition and porosity may exhibit different rates of scorification. EF (24)

Investigations into the Scorification of Refractory Materials. VI. Investigation of the Corroding Power and Constitution of Slags of Non-Ferrous Plants. (Untersuchungen über die Verschlackung feuerfester Stoffe. VI. Untersuchungen über die Korrosionskraft und die Konstitution der Metallhüttenschlacken.) H. Salmang & J. Kaltenback (Technische Hochschule Aachen). *Feuerfest-Ofenbau*, Vol. 8, Nov. 1931, pages 161-169.

12 references. The corrosive ability of the following oxides: FeO, Cu_2O, SnO, NiO, Fe_2O_3, Ni_2O_3, PbO, ZnO, CaO, BaO, Al_2O_3, SnO_2, Sb_2O_5, SiO_2, Cr_2O_3 and of $BaSO_4$, FeS and synthetic binary, ternary and quarternary silicate slags were quantitatively determined with respect to their scorification of refractory crucibles of the following analysis: 59.15% SiO_2, 37.55% Al_2O_3 and 2.4% Fe_2O_3. The experiments were carried out at 1320, 1410 and 1500° C. The original paper must be consulted for the wealth of data which are clearly presented in 19 illustrations. EF (24)

Furnace Walls. Part II. George P. Reintjes. *Blast Furnace & Steel Plant*, Vol. 19, Nov. 1931, page 1494.

By placing 2 interlocking tile at the angles of the furnace walls, it has been found unnecessary to maintain a mason at each corner of the walls, working on the "lead." Production per mason is increased and the strength of the furnace structure is improved. Cost of labor on the average furnace lining has been reduced about 25%. MS (24)

Advances in the Fields of Refractory Materials. (Neuere Fortschritte auf dem Gebiet hochfeuerfester Stoffe.) H. Trapp. *Die Metallbörse*, Vol. 21, Nov. 11, 1931, pages 1977-1978; Nov. 18, 1931, pages 2009-2010; Nov. 25, 1931, pages 2041-2042; Dec. 2, 1931, pages 2073-2074.

Differs between physical melting point of refractory materials and service temperature at which they can still advantageously be used. The avoidance of low melting compounds, eutectics, etc., due to the attack of metals, oxides, slags, ashes, etc., is discussed. The physical properties at elevated temperatures which are of decisive influence on the value of refractory materials and the determination of those physicals are taken up. The different materials on the market are critically discussed separately mainly referring to refractories on Al_2O_3, SiO_2, MgO and ZrO_2 base. EF (24)

Melting Diagrams of Highly Refractory Oxides III. (Schmelzdiagramme hochstfeuerfester Oxyde. III.) H. Von Wartenberg & W. Gurr. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 196, No. 4, 1931, pages 374-383.

The following melting temperatures have been determined: Fe_2O_3 (with impurities of Fe_3O_4) 1570° C., Mn_3O_4 1705°, ZnO 1810°, is very volatile, CeO_2 above 2600° C., NiO at 2090, CoO at 1935°, TiO_2 at 1850°, SnO_2 begins to evaporate rapidly at 1700°, SiO_2 can be evaporated easily above 1800° from $ZrSiO_2$. All diagrams are reproduced. Ha (24)

Special Refractories. *Metallurgist*, Sept. 1931, pages 136-138.

Extended abstract of a paper by D. Turner in the *Transactions of the Faraday Society*, Mar. 1931. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 152. VVK (24)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

The Influence of Some Contaminations on Refined Lead. (Einfluss einiger Verunreinigungen auf Raffinadeblei.) Thews. *Die Metallbörse,* Vol. 21, Aug. 8, 1931, pages 1492-1493.

Critically discusses an analysis of Pb for pipe material, suggested by the British Non-Ferrous Metals Research Association, running as follows: 98.25% Pb, 1.5% Zn, 0.25% Cd. The harmful effect of Sb, Bi, Cu, As, Ag, Zn, Cd, Sn, Na and Al is considered and the author urges the use of the purest refined Pb for material exposed to corrosion attacks. EF (27)

The Effect of Various Elements on the Quasi-Isotropic State and the Sensitiveness to Section Thickness of Cast Iron. *Foundry Trade Journal,* Vol. 46, Mar. 3, 1932, pages 147, 152.

An extended abstract of an article by Piwowarsky & Söhnchen, which appeared in *Die Giesserei* (Vol. 18, 1931, pages 533, 537). The article is accompanied by 5 diagrams. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 25. OWE (27)

Quality of Rails at Kertch Works. M. N. Karnaev. *Domez,* (Achievements of Metallurgy in USSR and Abroad), No. 10, 1931, pages 29-37. (In Russian).

Testing covered 378 heats of basic Bessemer rail steel for physical properties and the influence of As content. Analysis varied between 0.30 and 0.60 C while Mn was between 0.60 and 1.70. Impact tests were made on the rails and they were classified on the basis of rolling defects. 28.8 primes, 42.8 seconds and 28.4 scrap were obtained on the whole lot. Physical testing of 23 rails containing 0.14-0.175 As did not demonstrate the deteriorating effect of its content. (27)

Carbon and Iron. (Kohlenstoff und Eisen.) F. Rosendahl. *Die Metallbörse,* Vol. 21, May 23, 1931, pages 963-964; May 30, 1931, pages 1011-1012; June 6, 1931, pages 1059-1060.

The historical development of the Fe-C constitutional diagram, the different constituents therein and the phenomena occurring in plain carbon steels are reviewed. EF (27)

Manganese and Sulphur in Forging Steels. Archibald Allison. *Metallurgia,* Vol. 5, Mar. 1932, pages 171-172.

Discusses distribution and effects of S in rimmed and killed steels. Concludes that S is not to be too easily blamed for forging failures. JLG (27)

Nickel Alloy Cast Iron for the Automobile Industry. (Nickellegiertes Gusseisen im Kraftwagenbau.) H. Kalpers. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Feb. 7, 1932, page 60.

Ni in cast iron improves its structure, the hardness, tensile strength, machinability, and the resistivity against heat and corrosion; Ni castings are denser. Due to the better mechanical properties the weights of Ni castings can be lower than those of castings without Ni. GN (27)

Zirconium Alloys For Steel Production. (Zirkonlegierungen bei der Stahlherstellung.) *Bergwerk und Hütte,* Vol. 29, Feb. 5, 1932, pages 16-17.

General discussion as to how Zr affects the physical properties of steel. GN (27)

The Effect of Molybdenum on Medium-Carbon Steels Containing 1 per cent. to 2.5 per cent. of Manganese. G. Burns. *Engineering,* Vol. 132, Oct. 2, 1931, pages 443, 447-448.

Includes discussion. Condensed from paper read before the Iron & Steel Institute, Swansea, Sept. 29, 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 323. LFM(27)

Influence of Copper on the Acid Solubility of Low Carbon Ingot Steel. (Untersuchungen über den Einfluss des Kupfers auf die Säurelöslichkeit von kohlenstoffarmen Flussstahl.) Peter Bardenheuer & Gustav Thanheiser. *Mitteilungen Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 14, Report No. 196, 1932, pages 1-9.

Distinction is made between rate of solution in acids and weather resistance of material. After a thorough review of the literature, tests were made of the effect of Cu additions on solubility of low C steels, with varying P and S content, in N/5 solutions of H_2SO_4, HCl, HNO_3, and 2% citric acid. Time of solution attack 24 to 288 hrs. Cu additions were from 0.07 to 0.33% with Thomas steels. Cu additions for steels, with increasing amounts of P and S, were 0.01 to 0.70%. Cu additions to high P or S steels very strongly decreases rate of solution in H_2SO_4, HCl or citric acid. Cu scarcely affects solution rate of low P and low S steels, and with pure steel samples, Cu may even cause a higher rate of attack by acids. Solubility in HNO_3 is independent of Cu. Presence of $CuSO_4$ in solvent acid generally accelerates rate of solution, and the more insoluble steels are affected the most by the presence of $CuSO_4$ in the acid. Includes 22 references, 15 illustrations and 7 tables. DTR (27)

Constitution, Spontaneous Graphitization and Thermal Hysteresis of Titanium Cast Iron of Low Total Carbon Content. (Constitution, graphitisation spontanée et hystérésis thermique des fontes à bas carbone total). Jean Challonsonnet, *Comptes Rendus,* Vol. 194, Jan. 18, 1932, pages 283-285; *Journal du Four Electrique,* Vol. 41, Apr. 1932, page 142.

The author has prepared a series of Ti alloys of low C content, using Fe containing 2.3% total C, 0.9% Si, 0.3% Mn, 0.06% S, and 0.01% P as a base, and ferro-titanium containing 27% Ti as an addition agent. The materials used gave ingots 20 mm. in diameter and 200 mm. long, and rods 6 mm. in diameter and 100 mm. long. The latter were used for dilatation experiments. The article is accompanied by a table in which are quoted Brinell hardness numbers, the Curie points of the cementite, the temperatures of transformation, and the temperatures of spontaneous graphitization of a series of 9 irons containing from 0 to 1.93% Ti. The hardness of the alloys decreased as the Ti content increased up to 1.30% and then increased again. The author remarks that Ti behaves in its effect upon cast Fe very similarly to Si, modifying the various characteristics of the basic material in much the same way. The article is illustrated by one diagram. JDG + OWE (27)

The Influence of Silicon on Nickel Steel. R. Harrison. *Engineering,* Vol. 132, Oct. 2, 1931, pages 443-444, 450-452.

Includes discussion. Condensed from paper read before the Iron & Steel Institute, Swansea, Sept. 29, 1931. See *Metals & Alloys,* Vol. 1, Dec. 1931, page 323. LFM (27)

Notes on Bismuth Bearing Copper. (Bemerkungen über wismuthaltiges Kupfer.) C. Frick (Bergakademie Clausthal). *Die Metallbörse,* Vol. 21, July 29, 1931, pages 1395-1396.

The properties of Bi with special reference to its behavior in metallurgical refining processes are discussed. Tensile tests, conductivity measurements and rolling experiments were carried out with Cu containing additions of Bi up to 2%. Bi materially impairs the physicals: tensile strength drops 60% due to the addition of 2% Bi and the electrical conductivity decreases about 30% owing to contents of only 0.1% Bi. The maximum amount of Bi allowed to be present during hot rolling is 0.01% and 0.05% for cold rolling. Micro-structural examination disclosed that less than 0.05% Bi is in solid solution. At low concentrations Bi is encountered only at the grain boundaries. On solidification pure Cu crystals are segregating first and at essentially lower temperatures Bi solidifies. On heating internal stresses occur which might even result in disintegration of the contaminated Cu. EF (27)

Effect of Vanadium in High-Speed Steel. A. B. Kinzel & C. O. Burgess. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 468, Feb. 1932, 9 pages; *Iron Age,* Vol. 129, Feb. 25, 1932, pages 488-490.

The effect of increasing quantities of V on the hardness and cutting properties of steel containing 18% W and 4% Cr was studied. With 0.65 to 0.75% C the hardness of the heat treated steel decreased when the V content exceeded 2.5%. If the C was increased, however, the hardness failed to decrease, and lathe cutting tests proved that these high-C, high-V steels had a longer cutting life than the standard 18 W, 4 Cr, 1 V steel. The C should be increased about 0.2% for each 1% increase in V. A 1.5 C, 18 W, 4 Cr, 5 V steel forged well and had excellent cutting properties. Increased V with increased C in Co high-speed steels also improved the cutting properties. VSP + JLG (27)

Hardenable Nickel. (Härtbares Nickel). W. Kroll. *Metallwirtschaft,* Vol. 11, Jan. 15, 1932, pages 31-32.

Contains 2 references. Ni-C-Mg alloys were prepared containing from 0.07 to 0.90% C and 0 to 1.1% Mg. When quenched at 1100° C. and drawn for 24 hours at 500° C. a maximum Brinell hardness of 450 is obtained in the 0.6% C, 0.8% Mg alloy. The best alloys for working contain 0.5-0.6% Mg and 0.1-0.2% C and have a Brinell hardness of 270-370. These alloys have a tensile strength of 122-129 kg./mm.^{2} and 3.3% elongation. Monel metal can also be hardened by C and Mg additions, although to a lesser extent. Ca and Li have a similar effect to Mg, but on a smaller scale. A large number of other elements were alloyed with Ni, but no others were found to have the same effect as C and Mg. The structure of quenched Ni-C-Mg alloys is similar to low C steel. If quenched above 1200° C. the grains become very large. The alloys can be rolled at 1050° C. down to 800° C. In melting deoxidation with Mn is necessary and the ingots should be forged to break up the grain before rolling. The corrosion resisting properties are as good and in some cases better than V2A and 13% Cr steel. CEM (27)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

The Scaling and Corrosion of Steel for Steam Boilers and Superheaters. *Quarterly of the British Electrical and Allied Industries Research Association*, June 11, 1931, J/E/T 20, pages 10-14.

An investigation by Munzinger (A. E. G. *Mitteilungen*, Jan. 1930 *Das Kraftwerk*, page 26) on the cause of the failure of superheater tubes in a certain plant leads to certain fundamental considerations of the design and construction of superheaters. As a result of the investigation it is concluded that the heating surface of the superheater in question was too large and in consequence excessive steam and tube temperatures were attained. Deposits of salts in the tubes by checking the flow of steam probably magnified these temperatures. A strong reaction between the steam and steel tube was created. Although the outside of the tubes was overheated, there was much more corrosion on the inner walls. It is probable that the inner corrosion was accelerated by impurities carried over with the steam, and by free O in the feed water. It is possible also that the steam velocity was too low and thus all the tubes were not uniformly affected, some being insufficiently cooled by the flow of steam. The highest permissible temperature at the superheater exit for the normal operation of superheaters constructed of mild steel is given as 450° C. The determination of the rate of corrosion of the steel by means of the increase of the electrical resistance of a fine wire is an interesting confirmation of a similar method which has already been adopted at the National Physical Laboratory. The value of this research is increased when supplemented by the work of Fellows (*Power*, 1929, page 258). The conclusions drawn by Fellows are: (1) The rate of decomposition of metal increases as the temperature over which the steam passes is raised. (2) The rate of decomposition of the metal decreases as the thickness of the oxide formed on the surface increases. There is no evidence that this oxide attains sufficient thickness or imperviousness to protect completely the metal from further oxidation. WAT (29)

Properties of the Rare Metals for High-Temperature Service. W. H. Swanger (Bureau of Standards) *Symposium on Effect of Temperature on Metals, A.S.T.M.—A.S.M.E. Joint Research Committee*, 1931, pages 610-630.

For abstract of paper see *Metals & Alloys*, Vol. 2, Sept. 1931, page 193. In the discussion the statement is made that Ag is widely used for electrical contacts to the extent of a half million ounces annually, and is by no means confined to low-current, low-pressure service. Pure Ag is generally used but in certain cases small amounts of the Pt group metals are added. Ag alloys containing from 10-15% Cu are sometimes used for contacts. Alloys of Cu are, however, subject to oxidation. Pt, and particularly the Pt-Ir alloys containing 15-25% Ir are standard materials for high-duty contacts. Alloys of Ag and Pd, containing about 60% Pd are also coming into contact service. W is widely used in battery ignition systems in automobiles. The Pt versus 10% Rh-Pt thermocouple is the standard material for temperature measuring operations in the range 1100° to 1500° C. Thermocouples composed of Ir-Rh and Ir-Ru elements have been constructed and have been operated to temperatures up to about 2000° C. Recently an alloy containing 95% Pt with 5% Ni has been found particularly suitable for vacuum tube amplifier filaments. The life of such filaments is reported to be more than 25,000 hours. Pt and particularly the 10% Rh-Pt alloy is widely used for the catalytic oxidation of ammonia-air mixtures to produce nitric acid. Handy & Harman present short-time test data in graphical form for sterling Ag, coin Ag and fine Ag to 1200° F. Experiments on the volatilization of the platinum metals in different atmospheres and under varied conditions are in progress in the laboratories of Baker & Company, Inc. At present the results indicate that all the Pt metals volatilize in air or O_2 as oxide, with the exception of Pd, which loses weight by direct volatilization; that Pt and Rh lose weight very slightly in vacuo or in N_2 or H_2; but that the loss of Pd in vacuo is quite considerable. In contradiction to published data it seems that Rh loses more weight than Pd at 1300° C. WAT (29)

The Thermal Conductivity of Cast Iron between 0 and 100° C. H. Thyssen, Jean R. Marechal & Paul Lenaerts. *Engineering*, Vol. 132, July 3, 1931, page 10.

Abstract of a paper read before the Institute of British Foundrymen, June 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 283. LFM (29)

Creep of Metals. *Metallurgia*, Vol. 5, Mar. 1932, pages 155-156.

Describes the short-time method devised by Barr and Bardgett for determining creep limit. The samples are attached to a weigh bar, and as the material under test elongates the load decreases. For a given temperature there is a straight-line relationship between elongation during a given time and load. By obtaining creep values for 48-hr. tests with several loads, plotting these values and extrapolating to zero elongation, creep limits can be obtained. The test therefore requires only 2 or 3 48-hr. tests. JLG (29)

Some Considerations and Tests for Cast Materials for High-Temperature, High-Pressure Service. L. W. Spring. *Engineering*, Vol. 132, July 3, 1931, page 10.

Abstract of a paper read before the Institute of British Foundrymen, June 1931. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 26. LFM (29)

Some Thermal Properties of Tantalum. C. L. Utterback & L. A. Sanderman. *Physical Review*, Vol. 39, Mar. 1932, pages 1008-1011.

Measurements have been made on the total radiation from very pure, well seasoned Ta from 1000°-2220° K. A spectral temperature scale, $\lambda = 0.667\mu$, is given up to 2100° K. The variation of the resistance of Ta has been measured up to 2600° K. and the thermoelectric power of Ta with pure Pt has been measured up to 692° K. WAT (29)

Effect of Small Percentages of Certain Metals upon the Compressibility of Lead at an Elevated Temperature. Lyall Zickrick (General Electric Co.). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 14 pages.

Tested various grades of commercial Pb and Pb alloys by making compression test on specimens 0.75"x0.75" in cross section and 1.50" high at a temperature of 200° C. The tests indicated that different leads required different extrusion pressures. The softest were those of highest purity. Small amounts of Cu and Bi increased strength. A Southeastern Missouri Pb, not desilverized, required a greater pressure for a given deformation than a desilverized Bi lead. Sn and Sb increased the resistance to deformation of a high-purity or a Cu-bearing Pb to about the same value. A small amount of Ca apparently increases the deformation pressure. Tests from 160 to 240° C. were made on one brand of Pb. JLG (29)

Bearing Metals at Ordinary and Elevated Temperatures. (Lagermetalle bei normalen und höheren Temperaturen.) Thews. *Die Metallbörse*, Vol. 21, July 18, 1931, pages 1348-1349; Aug. 22, 1931, pages 1589-1590.

In the first part of this publication, bearing metals of Pb and Sn base are considered and the properties at room and elevated temperatures of some 16 representative analyses are tabulated. The balance of the paper confines itself to Cu bearing alloys and compiles in 3 tables interesting data on composition, tensile strength, elongation, proportional and elasticity limit, and Brinell Hardness at 21°, 150° and 310° C. EF (29)

High Pressures and High Temperatures for Steam Prime Movers. O. A. Wiberg. *Transactions Tokyo Sectional Meeting, World Power Conference*, 1929, Vol. 3, 1931, pages 1129-1146; *Engineering*, Vol. 133, Jan. 1, 1932, pages 27-28.

The object of this paper is to illustrate the possibilities of utilizing the advantages of high pressures and temperatures in power plant design. The analysis is based upon a series of tests of materials at elevated temperatures. It is shown that under certain assumptions as to limiting stresses, one group of materials, representing the C steels, gives a maximum thermal efficiency for a certain combination of temperature and pressure, while another group, representing the austenitic materials, gives increasing thermal efficiency for increasing temperature and decreasing pressure in a temperature range that can be considered as practical at the present time. The limitations due to the wetness of the discharge steam are shown to modify the results for the first group of materials in such a manner that the optimum combination of pressure and temperature is displaced towards a slightly lower thermal efficiency unless resuperheating is employed. The properties of the materials which are considered of the greatest importance in this connection are the fatigue limit for pulsating stress for lower temperatures and the creep limit for higher temperatures. Ultimate strength, fatigue, yield point and creep limit values for C and austenitic steels are compared graphically between room temperature and 700° C. The magnitude of the permanent deformation at the creep limit is considered. It restricts the applications of stresses to even less than 50% of creep limit for accurate machine parts. LFM + WAT (29)

Measurements by Means of Liquid Helium, XI. Resistance of Pure Metals at Low Temperatures. (Messungen mit Hilfe von flüssigem Helium XI. Widerstand der reinen Metalle in tiefen Temperaturen.) W. Meissner & B. Voigt. *Annalen der Physik*, Series 5, Vol. 7, 1930, No. 7, pages 761-797; No. 8, pages 892-936.

Almost all metals were tested between 1.2 and 273° absolute and the resistances given. The tests lead to the conclusion that the metals Hg, In, Tl, Th, Sn, Pb, Ta and Ti, and eventually Ru and Cb, become supra-conductive; Rb, Zr, V, As and Sb show a tendency to supra-conductivity and should, therefore, be investigated further below 1.2° C. absolute. Tables of characteristic temperatures listed according to the periodic system are given. Ha (29)

Atomic Heats of Ru, Rh and Pd, and the Coefficients of Expansion of Rh and Pd at High Temperatures. (Untersuchungen über den Verlauf der Atomwärmen von Ruthenium, Rhodium und Palladium sowie der Ausdehnungskoeffizienten von Rhodium und Palladium bei höheren Temperaturen.) H. Holzmann. *Siebert Festschrift*, 1931, pages 149-172.

The expansion of Rh is given by the equation

$$l_t = l_{20}\,[1 + 7.628 \times 10^{-6}\,(t - 20) + 0.002268 \times 10^{-6}\,(t - 20)^2]$$

for Pd, by

$$l_t = l_{20}[\,+ 10.637 \times 10^{-6}\,(t - 20) + 0.004594 \times 10^{-6}\,(t - 20)^2 - 0.001521 \times 10^{-9}\,(t - 20)^2].$$

Experiments were run to 1000° C. Atomic heat at constant pressure for Ru is $5.8415 + 0.0019242t$; for Pd, $6.2312 + 0.0016915t$; for Rh, $6.2221 + 0.0018834t$. Constant volume figures are also given. HWG (29)

The Temperature Dependency of the Specific Heat of the Elements of the Eighth Group of the Periodic System. (Ueber die Temperaturabhängigkeit der spezifischen Wärme bei den Elementen der achten gruppe des periodischen Systems.) F. M. Jaeger. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 203, Dec. 30, 1931, pages 97-103.

The equations expressing the exact behavior of the specific heat between 0 and 1650° C. as determined in the last years in the laboratory of inorganic and physical chemistry of the University of Groningen (Holland) are given for Pt, Os, Ir, Ru, Rh, Pa, Fe, Co and Ni. Ha (29)

Annealing Equipment at Franz Seiffert & Co. A. G. (Glüheinsichtungen bei der Firma Franz Seiffert & Co. A. G. Eberswalde.) R. Haspel. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Jan. 24, 1931, pages 112-113.

The difficulties encountered in parts subjected to high temperatures and high pressures are pointed out, particularly that with great variations in these conditions the aging in actual service is accelerated and the life of the part reduced. Careful heat treatment after the finishing process restores the texture of the material so that even at high pressure and temperature combined the aging can be reduced to a minimum. Large furnaces are described in which a whole assembled boiler can be annealed at 910° C.; they are heated by illuminating gas. Ha (29)

Construction and Charging of Ordinary Top Seals in German Blast Furnaces. (Bauart und Schüttung der auf deutschen Hochofenwerken gebräuchlichen Gichtverschlüsse.) Paul Reichardt. *Stahl und Eisen*, Vol. 52, Feb. 18, 1932, pages 157-165.

Report 125 of Blast Furnace Committee of Verein deutscher Eisenhüttenleute. Various types of blast furnace top construction, representative of those in practical use in 147 German blast furnaces, relations between various types of construction, measurement of furnace top seals and pouring of charge are described. DTR (31)

The Bunker Hill Smelter. A. F. Beasley, P. C. Fedderson, J. B. Schuettenhelm & J. W. Johnson (Bunker Hill & Sullivan Mining & Concentrating Co.) *Mining Congress Journal*, Vol. 17, Nov. 1931, pages 618-623, 632.

A thorough plant description of smelting, roasting, blast furnace treatment, Pb refinery and Cottrell plant is given. The S in the sinter for the blast furnaces must not exceed 2%. Therefore all of the sulphide ores and concentrates are pre-roasted in 5 D. & L. machines followed by crushing to 3/4" and final roasting in 5 more D. & L's. There are 4 blast furnaces, 48" × 180" at the tuyeres, and 20'9" deep from the feed floor to the tuyeres. The crucible is 2'3" deep with 2 tuyeres of water jackets forming the sides and ends of the blast furnace. Each furnace requires 5000-6000 ft.^{3} air/min.; average blast pressure is 25 oz./in.^{2}. Exclusive of coke each furnace consumes about 350 tons of charge/24 hrs. Coke added is from 10 to 11% of the charge, which is roughly 52% Pb. *Lead Refinery*: 6 100-ton drossing kettles are used. After the heavy dross has been removed, the bullion is pumped into a clean kettle. A 2" skim is made after blowing. This process of drossing and blowing lowers the Cu content from 0.90% to 0.04%. This dross approximated 9.5% of total bullion for 1930. *Softening*: The Pb is heated to 900° F. and pumped into 1 of 2 350-ton softeners. Softening time depends upon Sb and As. Bullion of average 1.5% Sb and 0.20% As can be softened in 15 to 20 hrs. with a furnace heat of 1600 to 1800° F. The As and Sb form a crust and are skimmed off. *Desilvering*: After cooling to 1000° F., Zn is added in excess of that which is necessary to remove the Au, the Au crust is skimmed off, and the remainder of the Ag is removed by adding additional Zn. The desilverized Pb containing 0.50 to 0.60% Zn and 0.10% Sb is heated to 750° F. and pumped to one of 2 250-ton refiners. Refining temperature is 1300° to 1800° F. The first blow starts at 1200° F. and lasts for 2 to 3 hrs., depending on the impurities and the temperature. At the end of the first blow, 98% Zn and 50% Sb have been oxidized and skimmed. A second blow is made which brings Sb down to 0.0030% and Zn to 0.0015%. The average time for refining a charge is 11 hrs. *Casting*: Refined Pb is allowed to cool to 900° F., tapped, pumped at 700° F. to a casting wheel having 150 molds, cast into 100-lb. pigs and loaded for shipment. Refined Pb produced is 4.2 tons/day/man employed in the Pb and Ag refineries. The Cu dross is treated in a 75-ton reverberatory furnace handling 63 tons/day, with 1% SiO_2 and 1% CaO rock. The Sb skim is treated in a by-product furnace with 3.5% coke and 3.5% galena. Coal used/ton of refined Pb produced, including complete refining of Pb, Au and Ag is 190 lbs.; oil/ton is 4.6 gals. The recovery of Pb, Au and Ag is described in detail. Cottrell Plant: The fume from the D. & L. sintering machines is treated in a Cottrell plant of 120,000 c.f.m. maximum gas volume. Temperature of gases at Cottrell inlet 100° to 125° F., and relative humidity at outlet of treater 50 to 60%. *Bag House*: The fume from the blast furnace, Pb refinery and Ag refinery is treated in a bag house. The refineries produce 40,000 ft.^{3}/min. of gas at 325° F., and the blast furnace 100,000 ft.^{3}/min. at 260° F. The temperature at the bag house inlet is kept below 200° F. 750 tons of fume are recovered/mo. on a 2 blast furnace basis. A McMichael automatic sampler, at an elevation of 75 ft. in the stack, shows an average Pb loss in the stack gas of 350 lbs./day. DTR (31)

The Sintering of Minette Blast Furnace Dust and Fine Ore. (Die Sinterung von Minette-Gichtstaub und -Feinerz.) R. Baake. *Stahl und Eisen*, Vol. 51, Oct. 15, 1931, pages 1277-1283; Oct. 22, 1931, pages 1314-1319.

Report 122 of the Blast Furnace Committee of the Verein deutscher Eisenhüttenleute, abstract of the author's doctor's thesis before the Clausthal Mining Academy. Includes discussion. Minette furnace dust and fine ore are suitable for sintering. Blast furnace dust with a grain size of about 0.05-0.5 mm. has minimum permeability. However, dusts of a smaller or a larger grain size can be sintered by the Dwight-Lloyd method without difficulty when moistened. The effect of water content, grain size, height of piling and porosity of the material upon the permeability was studied. In order to improve the permeability the following measures are necessary; careful supervision of the H_2O content of the dust or ore which is going to be sintered, very loose piling upon the sintering apparatus and avoidance of shocks of any kind during sintering. The results of preliminary sintering tests check with the actual results of a Dwight-Lloyd sintering plant. The following table indicates the favorable effect of the use of sinter upon the operation of a blast furnace.

Month	% sinter in burden	scrap in burden in % of pig iron	share of crushed minette in burden in % of total minette	% output of burden	production of pig iron per blast furnace in 24 hrs.	consumption of coke in % pig iron production[1]	deposit of dust[2] in % pig iron	deposit of dust[2] in % burden	Remarks
Dec. 1926	....	11.8	61.7	31.7	184 tons	111.3			
Jan. 1927	....	11.8	67.6	31.5	177 tons	113.0	about 35	about 11	fine ore not sifted
Feb. 1927	....	9.8	62.7	31.6	186 tons	109.2			
Nov. 1930	53.2	4.2	100.0	38.2	268 tons	87.5	5.5	2.05	fine ore sifted and sintered with Furnace dust.
Dec. 1930	56.8	9.3	100.0	39.8	285 tons	86.3	5.95	2.20	
Jan. 1931	47.0	8.8	100.0	37.7	284 tons	89.6	4.40	1.70	

[1]Coke containing: 10% ash, 5% moisture.
[2]Without Filter dust.

GN (31)

Induced Draft Sintering of Iron Ores. (Untersuchungen über die Saugzugsinterung von Eisenerzen.) Walter Luyken & Ludwig Kraeber. *Mitteilungen Kaiser-Wilhelm-Institut für Eisenforschung*, Vol. 13, Report No. 192, 1931, pages 247-260.

Hematite was sintered in a 5 kg. experimental induced draft sintering apparatus, studying the effect of varying draft, amount of fuel, H_2O additions, content of fines, and amounts of other materials, such as SiO_2 and CaO. The passage of air through materials of varying degrees of fineness and H_2O content was determined. Maximum temperatures in the hottest zone ran above 1600° C. and the material became fused temporarily. Increasing amounts of fuel increased sintering time, increased draft decreased time. According to the chemical composition of the raw material, there could be obtained as newly-formed substances, magnetite, little hematite, Fe silicate, Ca ferrite, Ca silicate and glass. The size of pieces and suitability of the sinter were affected by amount of fuel used, draft, and chemical composition. Composition of material influences softening of sinter at high temperatures. Appreciable change in porosity could not be obtained by varying sintering conditions. Reduction by H at 600° C. showed that formation of compounds of Fe oxide with CaO or SiO_2 caused decrease in amount of reduction. When both CaO and SiO_2 are present in raw material in sufficient quantities, a formation of $CaSiO_3$ results; no harmful effects are caused when this sinter is used in the blast furnace. Includes 18 references. All results were confirmed on a 20 kg. sintering apparatus with a 33 × 33 cm. hearth surface. DTR (31)

Author Comments on Cyanides. Wm. McConnachie, (Coltness Iron Works). *Blast Furnace & Steel Plant*, Vol. 19, Nov. 1931, pages 1474-1478.

Reply to S. P. Kinney's discussion in Aug. 1931 issue of author's "Importance of Cyanides in Iron Smelting" published in the July 1931 number. Of the data in U. S. Bureau of Mines Technical Paper 390 showing cyanide and alkali in gas from the slag notch of a blast-furnace, only that sample containing the greatest amount of cyanide should be regarded as approximately representing the concentration of alkali in the gas of the well when in good working order. The high alkali concentration of this sample is not due to projected accumulations. Cyanides leave the well as vapor, but need not rise to any great height in the furnace before they are destroyed in decomposing Fe silicate. Intercepted alkalies return to the well as a thin liquid primary slag, running much ahead of the solid materials. This rapid circulation of the alkalies in the bottom of the furnace enables them to do the vast amount of work which must be credited to their transformation. MS (31)

The Handling of Pig Iron. Arthur E. Linnell. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 120-124.

A discussion (1) of handling and molding methods in the sand casting of pig Fe and (2) of pig casting machines. CHL (31)

Economics of the Hot Air Blast. J. B. Fortune. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 115-119.

The mechanical devices which make for greater efficiency in the production of high-temperature hot blast, such as burners, valves, etc., are discussed. CHL (31)

Rapid Wear of Blast Furnace Hearths. A New Method for Cooling. (Usure rapide des cuves de hauts-fourneaux. Un nouveau mode de réfrigeration). A. Cousin. *Revue de Métallurgie*, Vol. 29, Feb. 1932, pages 57-60.

The use of H_2O for cooling hearth and boshes of a blast furnace is satisfactory, but much better efficiency and greater life of the lining can be obtained by cooling with air. A 35 kwh. blower supplies enough air for a 300 ton stack. Holes 4.5 cm. in diameter and about 40 cm. long are provided in the bricks and the air is fed into them. With this arrangement, using 1700 holes, the cooling surface for a 300 ton furnace is 99 m.^{2}. The regulation of cooling is quite flexible and efficient and the uniformity of cooling is greatly increased. The first stack so equipped at Seraing Works of Societe Cockerill has lasted twice as long as any water cooled one and still no wear can be detected. JDG (31)

Efficiency of Blast Furnace Gas Disintegrators. I. N. Goff & T. S. Washburn. *Blast Furnace & Steel Plant*, Vol. 19, Nov. 1931, pages 1462-1466.

The efficiencies of 2 types of gas disintegrators and towers of the Brassert type recently installed in the Chicago district, methods of use and calculations are described. Results of 8 of 13 tests made show that the lowest dust content is obtained with the 4-bar type of disintegrator which gave a gas containing 0.0095 grains of dust/ft.^{3} of gas. An improved 4-bar type running at another plant in the same district is attaining the same results as to cleanliness, while the h.p. is comparable to that of the 3-bar machine. Minimum dust content obtained with the 3-bar type is 0.002 grains/ft.^{3}. There is an ideal H_2O flow above or below which the dust content increases. Average analysis of dust collected was 21.86% SiO_2, 8.11% Fe_2O_3, 17.16% Al_2O_3, 27/74% CaO, 5.36% MgO, 1.47% MnO and 15.62% C, S and alkalies. There was apparently no relation between the composition of dust and the cleanliness of the gas. The extreme fineness of the dust delivered by the gas to a stove favors its being carried through with the stack gases. MS (31)

Manufacturers' Literature Reviews

412 **Forging Furnaces**—The Electric Furnace Co., Fuel Division, Salem, Ohio, has for distribution, a reprint of an article illustrating and describing various types of continuous and batch type forging furnaces with automatic temperature control, used in modern forge shop practice. The furnaces illustrated include pusher, rotary, slot type, multi-door batch type, forging and rotary end heating furnaces. This company will also supply reprints of an article dealing with a novel semi-continuous furnace for low cost production nitriding and one devoted to a new fuel fired car type furnace of latest design.

413 **Illium**—A booklet prepared by the Burgess-Parr Company, Moline, Ill., gives a short sketch of the development of Illium, a corrosion resistant non-ferrous alloy, gives charts comparing it with other alloys and describes its physical properties. Suggestions for its application in various industries are given together with illustrations of a variety of delicate and odd shaped parts which have been made from Illium.

414 **Copper Plumbing**—Bulletin No. 39 of the Parker Appliance Co., 10320 Berea Road, Cleveland, Ohio, illustrates their new line of copper plumbing fittings.

415 **Industrial Application of the X-Ray**—Bulletin No. 284 of the General Electric X-Ray Corporation, Chicago, Ill., presents several extracts from authorities identified with this branch of science and supplements them with a series of specific cases of the application of X-rays in industrial work.

416 **Alloy Steel and Alloy Iron**—Bulletin 528 of the Mackintosh-Hemphill Co., Pittsburgh, Pa., describes in a brief way their alloy steels, Machempite, Machempite A, B, and C and their alloy iron, Iralite. The general properties of each alloy are given together with suggested applications.

417 **Grinding**—The feature article in the May issue of *Grits & Grinds*, published by the Norton Company, is "Correct Wheels Required for Grinding the Cutting Carbides." It is well illustrated.

418 **Refractories**—Bulletin No. 3, 1930, of the Atlas Lumnite Cement Co., Inc., Chrysler Building, New York, N. Y., is a popular technical discussion of "Lumnite," a new type of binder for making refractory concrete linings, shapes and mixtures. Bulletin No. 3, 1931, is a manual for making heat-resisting, non-spalling concretes suitable for refractory linings in fire doors, furnaces, cupolas, etc.

419 **Microscopes**—The Bausch & Lomb Optical Co., Rochester, N. Y., has issued an attractive booklet on their new comparison microscope for studying evidence. This instrument is designed for the examination and comparison of bullets, shells, finger prints, textiles, or any microscopic material calling for the use of low magnification.

420 **Exhaust Fans**—Bulletin No. 166 of the Duriron Co., Inc., Dayton, Ohio, covers the engineering and mechanical features of Duriron fans for the ventilation of pickling rooms, laboratory hoods, etc. The physical and chemical properties of Duriron, which make up all parts of the fans coming in contact with fumes, are discussed in Bulletin 150.

421 **X-Ray and the Foundry**—The Kelley-Koett Mfg. Co., Inc., Covington, Ky., has published an attractive pamphlet on the application of X-rays to the inspection of castings and welds. Several radiographs are reproduced and explained.

422 **Refractory Brick**—A circular descriptive of their new Laclede Mullite brick has been issued by the Laclede-Christy Co., St. Louis, Mo.

423 **Gas Indicator**—The M-S-A combustible gas indicator was developed for practical use in detecting flammable gases and vapors. It is described in a circular sent out by the Mine Safety Appliances Co., Pittsburgh, Pa.

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METALS & ALLOYS, 3619 Forbes St., Pittsburgh, Pa.

Please have me supplied with a copy of each piece of Manufacturers' Literature listed below.

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ALPHABETICAL INDEX TO ADVERTISERS

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424 **Condenser Tubes**—A pamphlet describing Anaconda super-nickel and Ambrac condenser tubes has been issued by the American Brass Co., Waterbury, Conn. Physical characteristics and specifications for these tubes are given.

425 **Cadalyte**—An attractive 30 page booklet issued by the Grasselli Chemical Co., Cleveland, Ohio, provides essential data on the properties, application and uses of cadmium and Cadalyte, a process and product for cadmium plating. The booklet is well illustrated.

426 **Magnetic Separators**—A treatise of the separation of such feebly-magnetic substances as iron oxide, garnet, hematite, slate and wolframite from non-magnetic substances is included in a new bulletin published by Dings Magnetic Separator Co., Milwaukee, describing the new Dings Type IR Super-High Intensity magnetic separator.

427 **Artificial Furnace Atmosphere**—The Ajax Electric Company, Philadelphia, is distributing reprints of an article entitled "Artificial Furnace Atmosphere Created from Ammonia."

428 **Matrix Alloy**—The Cerro de Pasco Copper Corporation, New York, N. Y., has compiled a 30-page booklet devoted to their new alloy of bismuth, lead, tin and antimony. It gives full information on the application of this alloy, together with many sketches, for assistance to the tool and die designer. The same company has issued reprints of an article entitled "Bismuth, Essential to Fusible Alloys, has Additional Possibilities."

429 **Stainless Steel Castings**—A pamphlet prepared by the Cooper Alloy Foundry Co., 150 Broadway, Elizabeth, N. J., contains a table giving various analyses of their stainless steels together with suggested uses for each one. A table comparing the physical properties of castings made from these steels with those from other materials is given.

430 **Acetylene Torch**—Bulletin No. 200 of the Vulcan Copper & Supply Co., Cincinnati, Ohio, is devoted to their Model B-2 acetylene torch. It describes the torch itself and illustrates and discusses the welding and cutting tips for special purposes which increase its usefulness.

431 **Furnaces**—Bulletin No. 34 of the W. S. Rockwell Co., New York, discusses their continuous bright annealing furnaces, both electric and fuel fired. A sketch of a typical special-atmosphere flex-belt conveyor furnace is given.

432 **Lead**—The July issue of this publication of the Lead Industries Association, New York, contains short articles on a number of interesting uses of lead.

433 **Furnaces and Furnace Equipment**—Two recent bulletins of the Surface Combustion Company, Toledo, Ohio, are of interest. One describes an installation of their cast alloy Conveyor Hardening Furnace at the Flannery Bolt Company, giving operating data and illustrations of various types developed for different work. The other bulletin shows several of their 46 types of burners which are furnished in more than 400 different sizes.

434 **Whiting Founder**—The first issue of a new quarterly publication of the Whiting Corporation, Harvey, Ill., contains several interesting articles devoted to cast iron.

435 **Expansion Joints**—A new illustrated bulletin of 8 pages describes in detail the "Flexodisc" packless expansion joint suitable for handling expansion in steam mains, miscellaneous piping and for special expansion problems, available in sizes from 3" to 30", the expansion element being of alloy steel. Croll-Reynolds Engineering Co. Inc., 17 John St., New York.

PROPERTIES OF METALS (1)

Metallurgy of Copper. V. Y. Mostowitch. Siberian Scientific Technical Library, Tomsk, 1931, in Russian. Paper, 6 x 9 inches, 372 pages. Price 6 rubles.

Looking through the pages of Professor Mostowitch's work one finds an average college text book without any particular advantages or glaring defects, except the poverty of technical terminology. Normal adaptation of foreign terms to any language takes a considerable time even under healthy conditions of industrial development, but the transplanting of Montana shop vernacular into the heart of Siberia by simply transcribing English words with Russian characters is not the way of solving this problem. Newly coined names of processes and operations cannot escape such handling without some difficulty but transcription of "cake," "bottom," "kiln," etc., borders on the ridiculous.

It is reading between the lines which gives to the book a particular interest. This is a Russian book for Russian students, but it does not contain a single description of any plant in that country. Besides the usual official buncombe regarding copper production in the years to come not a single figure is given bearing on home situation. Either a professor of metallurgy does not know that there is a copper industry in his native land, or its state is not fit even for home consumption. Amusing or tragic, depending on the viewpoint, but always acutely significant is the need for recurring to, say, Idaho figures when dealing with any subject from the workability of copper deposits up.

From a metallurgical standpoint the book is practically of no interest to the outside world; as a mirror of the present conditions it is quite amusing, and Professor Mostowitch undoubtedly deserves many thanks for his efforts to resurrect a part of Russian technical literature. (1)-B-

Metallurgy of Nickel. V. Y. Mostowitch. Siberian Scientific Technical Library, Tomsk, 1931, in Russian. Paper, 6 x 8 inches, 105 pages. Price 1.40 rubles.

In the whole scientific literature it would be difficult to point at any single work exhaustively covering all phases of nickel manufacture and its properties. Many good books are available but a perusal of many will be required before a complete picture will appear before the eyes of the reader, so that in Russia the process of obtaining adequate information would become particularly difficult and lengthy. Professor Mostowitch did much to relieve this situation by compiling from the world's literature a set of data presented in this booklet. The whole field is covered, though somewhat briefly, particularly in applications of nickel, where the text becomes almost sketchy. One feels that the pamphlet will find a hearty welcome among the students of Russian schools for which it is intended. (1)-B-

Investigation of the Glow-Electric Emission of Metals in the Neighborhood of Their Melting Points. (Untersuchung über die glühelektrische Emission von Metallen in der Umgebung ihres Schmelzpunktes.) Irmgard Ameiser. *Zeitschrift für Physik*, Vol. 69, Apr. 23, 1931, pages 111-140.

Cu, Au and Ag were tested by a new method which avoids falsification of the test results by emission of the containers. The emission energy for the solid and liquid state is independent of temperature. Ha (1)

The Theory of the Fine Structure of the Magnetization Curves of the Single Crystals. (Zur Theorie der Feinstruktur der Magnetisierungskurven der Einkristalle.) N. Akulov. *Zeitschrift für Physik*, Vol. 69, Apr. 23, 1931, pages 78-99.

Previously developed methods are extended so that they permit a more exact calculation of the magnetization curves of single crystals. The values thus calculated for Fe agree well with tests made by other investigators. Ha (1)

Magnetism in Discontinuous Media. L. W. McKeehan. *Revue Modern Physics*, appendix to *Physical Review*, Vol. 2, Apr. 1930, pages 477-505.

The various theories of magnetism are reviewed and in particular the modern theory of ferromagnetic crystals is treated. Ha (1)

The Anisotropy of the Magnetization of Ferromagnetic Crystals. (Zur Anisotropie der Magnetisierung ferromagnetischer Kristalle.) F. Bloch & G. Gentile. *Zeitschrift für Physik*, Vol. 70, July 6, 1931, pages 395-408.

The paper discusses and calculates the dependence of the magnetizing energy on the direction of the crystal. Ha (1)

On Molecular and Atomic Volumes. XXXII. The Atomic Volumes of the Elements at the Absolute Zero Point. (Ueber Molekular- und Atomvolumina. XXXII. Die Nullpunktsvolumina der Elemente). Wilhelm Biltz & Karl Meisel. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 198, May 28, 1931, pages 191-203.

The densities and atomic volumes of the elements at ordinary temperatures and the atomic volumes at — 273° C. are tabulated. WHB (1)

A Thermal Effect Shown by Bismuth and Related Metals. (Ueber einen Warmeeffekt beim Wismut und verwandten Metallen.) L. Bergmann. *Physikalische Zeitschrift*, Vol. 32, Aug. 1, 1931, pages 584-585.

Majorana found that if a piece of Bi inserted axially into a small coil of many turns of wire be illuminated by intermittent light, then electric currents are produced in the coil. This effect has now been observed with Sb, Mg, Cd, Zn, Sn, the "elektrometall" alloys CM and ACM, a special bronze, and alloys containing Bi and Sb. The effect is shown most strongly by Bi. Sb comes next in order. It is shown that the effect is partly thermoelectric in character, and partly of unknown, but possibly of photoelectric origin. WHB (1)

Beryllium in Industry. (Das Beryllium in der Technik.) Johannes Becker. *Zeitschrift für die gesamte Giessereipraxis, Das Metall*, Vol. 52, May 24, 1932, pages 58-59.

The physical and mechanical properties of Be and its use in industry are described. It has already many applications, and these are rapidly increasing in number. WHB (1)

Properties of Metallic Cadmium. (Eigenschaften des metallischen Kadmiums.) Thews. *Die Metallbörse*, Vol. 21, Apr. 25, 1931, pages 772-773; May 2, 1931, page 820.

Physical, chemical and technological properties of Cd are summarized. EF (1)

The Specific Resistance of Thin Metal Layers, Especially of Silver and Tungsten. (Untersuchungen betreffend den spezifischen Widerstand dünner Metallschichten, insbesondere bei Silber und Wolfram.) L. Hamburger & W. Reinders. *Recueil des Travaux Chimiques des Pays-Bas*, Vol. 50, April 15, 1931, pages 441-474.

Thin layers of Ag were formed by sublimation and condensation on glass walls. The thickness of the layer was calculated from the weight of the layer and the density of the metal by assuming this to be the normal density of the compact metal. The average thickness of the Ag layer formed at room temperature was 16 atoms, of the W layer 1 atom. At — 185° C. each metal layer was 2 atoms thick. From measurements made at room temperature and at the temperature of liquid air, it is concluded that the specific resistance of thin metal layers depends upon the metal employed, the thickness of the layer, the type of formation, the temperature and changes in temperature, the foundation upon which the metal is deposited and other influences. The specific resistance of thin layers is greater than that of the massive metal, the deviation being the greater, the more refractory the metal and the lower the temperature at which condensation takes place. W layers 2 $\mu\mu$ thick formed at — 185° have a negative temperature coefficient. Thin layers of both Ag and W are attacked by moist O, but not to any great extent by the dry gas. Ha (1)

The Structure of Thin Metal Layers, Especially of Tungsten and Influence upon the Specific Conductance. (Zur Struktur von dünner Metallschichten, im besonderen von Wolfram und deren Einfluss auf die spezifische Leitfähigkeit.) W. Reinders & L. Hamburger. *Recueil Travaux Chimiques Pays-Bas*, Vol. 50, April 15, 1931, pages 475-490.

See preceding abstract. From probability calculations it is concluded that the thin layers of W that have condensed at low temperatures upon glass and quartz possess a completely amorphous structure. In thicker layers and at higher temperatures the atoms group themselves into a crystalline orientation. The high specific resistance of thin metal layers is assumed to be due largely to the abnormally large spacing between atoms. The negative temperature coefficient of W is attributed to the increase in thermal motion at higher temperatures. As the thickness of the layers increases, the atoms arrange themselves in a more orderly manner and with a decreased spacing; the temperature coefficient can finally become positive. In the case of less refractory metals, the grouping of the atoms may result in grains of small coherence, so that the condition is noticeable only at greater thicknesses. Nonmetallic inclusions can likewise lower the condition. Ha (1)

The Principal Factors in the Castability of Pure Metals. (Facteurs principaux de la coulabilité des métaux purs.) A. Portevin & P. Bastien. *Comptes Rendus*, Vol. 194, Feb. 15, 1932, pages 599-601.

F being the freezing point of the metal, θ_1 its casting temperature, θ_2 the temperature of the mold, it is evident that the length λ of the spiral ordinarily used in testing the fluidity of metals increases inversely with F-θ_2, becoming infinite when θ_1 equals F. The lowest temperature of casting increases with θ_1-F, the more so as the specific heat c, the density d, and the latent heat of solidification L of the metal are increased. The most simple expression for fluidity is then given by the formula

$$\lambda = \mathrm{K.d}\frac{c(\theta_1 - F) + L}{F - \theta_2}$$

Mathematical analysis of the phenomenon of fluidity leads to a more complex formula which for low values of $(\theta_2 - F)/F$ (less, for example, than half) reduces to

$$\lambda = \alpha\frac{d.c(\theta_1 - F)}{F - \theta_2} + \beta\frac{L.d}{F - \theta_2}$$

where α and β are coefficients depending upon the dimensions of the mold and the nature of the material forming it, on the height of pouring, and also (but in a proportion which it is difficult to define) on the viscosity of the metal. The authors give a series of curves, showing the relationship between λ and $\theta_1 - F$ for Sn, Cd, Pb, Zn, Sb, and Al and showing that the fluidity is a linear function of temperature. They likewise show that the coefficient β varies little from one metal to another and that the viscosity does not seem to affect it. Further, the coefficient α varies from one metal to another and is a function of the viscosity. The authors believe that the forces of surface tension do not appear to play an important part in fluidity. In the case of the mold which they use, calculation shows that the magnitude of these forces is in the neighborhood of 200° C. In conclusion, they state that fluidity is a result of complex factors, among which the thermal properties (specific heat, latent heat of solidification, freezing point) of the metals play a part quite as important as their viscosity. OWE (1)

The Allotropic Transformation of Barium in the Solid State. (Sur une transformation allotropique du baryum a l'etat solide.) E. Rinck. *Comptes Rendus*, Vol. 193, Dec. 21, 1931, pages 1328-1330.

A description of the preparation of pure barium by means of the Guntz process is followed by the results of experiments designed to determine certain of the physical constants of the metal.

Fusion point		710° ± 2° C.
Electrical conductivity	(0° C.)	0.28 x 10^5
" "	(18° C.)	0.25 x 10^5
Temperature coefficient of resistivity	(0° C. to 100° C.)	0.0061
Density	(17.2° C./4° C.)	3.740

The author reports that barium undergoes an allotropic transformation at 375° C., the α form being stable below this temperature and the β form being stable between this temperature and the fusion point. OWE (1)

Cadmium. W. G. Rumbold. *Mining Journal*, Annual Review No., Feb. 13, 1932, page 11.

Properties and uses are discussed. AHE (1)

Special Bronzes for Telephone and Telegraph Wires. (Spezialbronzen für Telephon- und Telegraphendrähte.) F. FREUDE. *Die Metallbörse*, Vol. 21, Aug. 8, 1931, pages 1491-1492; Vol. 21, Aug. 15, 1931, pages 1539-1540; Sept. 5, 1931, pages 1673-1674.

The Austrian, Roumanian and Polish specifications for telephone and telegraph bronze wires regarding ultimate strength, bending properties and electric conductivity are tabulated. The peculiar melting and casting operations to meet the electrical requirements are described in detail. The deoxidizers, mainly Cd, and the other additions to improve the physicals, mainly Si and Sn, are quantitatively given. The rolling operations are fully outlined and data on the succeeding roll passes are stated and the sections illustrated. The balance of the paper considers the production of these special bronze wires by cold drawing and details the reductions in the wire's cross sections. Particular emphasis is placed on proper lubrication technique. EF (2)

Alloys of Lanthanum and Aluminum (Le leghe tra lantanio e allumimio). G. CANNERI. *La Metallurgia Italiana*, Vol. 24, Feb. 1932, pages 99-103.

Thermal analysis indicates the existence of LaAl, $LaAl_2$ (m.p. 1424° C.) $LaAl_4$ (m.p. 1222° C.). There is a eutectic at 80 atomic % La, 20 atomic % Al and 542° C., and one at about 97 atomic % Al, 3 atomic % La and 658° C. La Al_4 inverts from the β to the α form at 816° C. The equilibrium diagram is drawn on the basis of the thermal analysis and some microscopic evidence. Solid solubility limits were not determined, nor were X-ray studies made. Moist air slowly attacks the alloys high in La, especially those containing free La. Those high in Al are quite stable, the surface remaining bright. The hardness is stated not to vary much from that of the pure metals up to 35 atomic % Al on the La side and between 100 and 80 atomic % on the Al side. Hardness values are not given. Maximum hardness (6 on the Moh scale) is at the composition La Al_2, and that compound is exceedingly brittle. From 60 to 75 atomic % Al the alloys disintegrate spontaneously. This is thought not to be due to an inversion of La Al_2 but rather to the effect of gas pressure due to reaction of carbide, as impurity, with atmospheric moisture, shattering the brittle alloy. The purity of the La and Al used is not stated. Cooling curves only were apparently used. The mass of alloy used in the thermal analysis is not stated. HWG (2)

Bearing Metals and Their Behavior in Operation. (Die Lagermetalle und ihr Verhalten im Betriebe.) KUNZE. *Maschinenbau*, Vol. 10, May 1931, pages 664-670.

General directions for the selection of bearing metals are developed, their basic properties, testing methods and equipment are described and test results reproduced. Ha (2)

Aluminum Alloys. F. KELLER (Aluminum Co. of America) *Metal Stampings*, Vol. 5, Feb. 1932, pages 43-46, 129-130.

Commercially pure Al in the annealed state has a tensile strength of about 13,000 lbs./in.², increased to 24,000 lbs./in.² by cold working. Much stronger alloys are made by adding one or more of the constituents Cu, Mg, Si, Mn and Fe. The names and distinctive numbers of the principal Aluminum Co. of America alloys, their chemical compositions, industrial uses and suitability for castings (either sand or permanent mold), forging, cold working or heat treating are given in some detail. Alclad 17S is Duralumin 17S with thin integral surfaces of pure Al. It shows high resistance to atmospheric corrosion, the more so since the core is electrolytically protected by the Al and small scratches or bruises on the surface do not become nuclei for corrosion. CMB (2)

Electric Properties of Diluted Solid Solution Alloys. I. Gold Alloys. (Elektrische Eigenschaften verdünnter Mischkristallegierungen.) J. O. LINDE. *Annalen der Physik*, series 5, Vol. 10, 1931, No. 1, pages 52-70.

Study of a series of alloys of Au with Cu (0.94 and 3.15%), Ni (1.16, 2.14 and 3.05%), Co (0.95, 2.11 and 2.65%), Fe (1.07, 1.89, 2.17 and 3.32%), Mn (0.77 and 2.08), Cr (1.8 and 2.84%), Ag (0.99, 1.88, 2.87 and 2.93%), In (0.86 and 1.68%), Sn (0.93, 1.81 and 3.02%), Pd (1.15, 2.88 and 4.46%), Pt (0.99, 1.96 and 3.0%), Rh (0.24, 0.50, 1.05, 2.09 and 3.03%), Ru (0.83, 1.84 and 2.78%), Ir (0.99, 1.82 and 2.76%) and Os (0.96, 1.84 and 2.96%). Temperatures: from 20° to -190° C. The results are tabulated; it is shown that the atomic increase of resistance does not always increase with increasing, horizontal distance of the dissolving and the dissolved metal; the transition elements show exceptions. Ha (2)

Some Non-Ferrous Engineering Alloys. WESLEY LAMBERT. *Institution Engineers & Shipbuilders in Scotland, Advance Copy*, 1930, pages 1-19.

The use of non-ferrous alloys is not justified on the grounds of strength and hardness alone, on account of the superior mechanical properties of carbon and alloy steels, but is favored by engineers from considerations of resistance to corrosion, thermal conductivity, anti-frictional qualities and artistic attractiveness. The mechanical proporties and application of brass, manganese-brass, aluminum-bronze, phosphor-bronze, lead-bronze, Monel-metal and anti-friction white metals are dealt with and also the methods of compounding and handling these alloys. The desirable properties of an anti-friction-bearing lining are fully discussed and the virtues of a tin-base Babbitt as against those of a lead-base metal, compared. See also *Metals & Alloys*, Vol. 2, Mar. 1931, page 62. (2)

A Corrosion Resisting Aluminum Alloy. (Eine korrosionsbeständige Aluminiumlegierung.) HANS WOLF. *Die Chemische Fabrik*, Vol. 4, Dec. 30, 1931, pages 493-494.

Contains 3 references. An alloy called AW 15 developed by the Aluminium-Walzwerke Singen contains less than 2% Mn and the balance Al with the usual Fe and Si impurities. Its corrosion resistance tested by several different methods is better than that of pure Al. In 1 mm, sheet form, soft temper, it has a tensile strength of 11.8 kg./mm.² elongation 27%, Brinell hardness 32, hard temper tensile strength 26 kg./mm.², elongation 3% and Brinell hardness 59. Its deep drawing qualities are almost as good as pure Al and it can be satisfactorily cold rolled and stamped. After cold working it should be annealed at 500 to 520° C. It can be electroplated, soldered and welded. CEM (2)

Heredity Influences on the Quality of Cast Iron. Correspondence from A. PORTEVIN, Paris, France. *Metal Progress*, Vol. 21, Jan. 1932, pages 71-72.

Summarizes briefly the problem indicated as important at the Milan Exhibition and deplores a tendency on the part of foundrymen to assign a significance to those phenomena of heredity and oxidation which is not justified by the facts. WLC (3)

A Low Alloy Steel for Large-Tonnage Applications. A. B. KINZEL. (Union Carbide & Carbon Research Laboratories, Inc.). *Iron Age*, Vol. 128, Dec. 31, 1931, pages 1686-1688.

Deals with a series of alloy steels chiefly composed of Cr, Mn and Si, and to which the name of Cromansil has been given. The need of a superior structural alloy steel led to the development of Cromansil steels. The best balance of alloy content is achieved by the following analysis range: Cr—0.4 to 0.6%; Mn—1.1 to 1.4%; Si—0.7 to 0.9%. This may be varied for special applications. Solidification of Cromansil steels in the ingot is different from that of either straight Cr or Mn steels; segregation is low and dendrites are small. The low cost combined with other desirable features indicates their use in many applications. VSP (3)

The Permanent Growth of Gray Cast Iron. W. E. REMMERS. *Fuels & Furnaces*, Vol. 9, Apr. 1931, pages 455-456.

Abstract of a paper presented before the Chicago section of the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 1, Oct. 1930, page 791. (3)

Steel-Like Cast Iron Made in Cupola. (Stahlähnliches Gusseisen aus dem Kupolofen.) M. REISSERT. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 53, Feb. 7, 1932, pages 56-58.

The paper briefly reports the test results on cast irons which were made according to the Corsalli method with a C content between 1—2%. Such a cast iron has tensile strengths of from 64,000 to 75,000 lbs./in.² and can be made in the cupola without difficulties. GN (3)

A Comparison Between the Physical Properties of Rails Produced by the Open-Hearth and Duplex Processes. E. A. WRAIGHT (Metallurgical Inspector, Indian Stores Department). Government of India Central Publication Branch, Calcutta, 1931. Paper, 6¼ x 9¾ inches, 18 pages. Price 1 Rupee.

Rails made by the Tata Iron & Steel Company were tested. Open-hearth and duplex heats were cast into 3 and 5 ton ingots, and 90 lb. rails rolled therefrom. Some rails were rolled direct, others from reheated blooms (wash heat), and still others from blooms cooled overnight and reheated. Tensile and drop tests are reported. The C ran between 0.55 and 0.65%, Mn from 0.75 to 0.90%. The C composition of the duplex heat was intermediate between those of the open-hearth heats, but higher in Mn than either. The deflection of duplex on the drop test was intermediate to those of the open-hearth heats, as was the tensile strength, but the elongation was a trifle lower than even that of the higher C open-hearth heat. The duplex rails are adjudged equivalent to open-hearth. There was some indication that rails tend to show slightly higher deflection on the drop test when rolled from reheated blooms, and the rails from ingots toward the end of a cast showed the same tendency. No notable difference in grain size was noted on rails from the 3 and the 5 ton ingots. Grain size was, however, slightly larger in rails from wash-heated blooms. HWG (3)

The Production of 18-8 Steel Wire. W. H. WILLS & J. K. FINDLEY. *Rolling Mill Journal*, Vol. 5, Oct. 1931, pages 671-673.

The procedure of drawing and reheating and the mechanical properties of this corrosion resistant material are described. See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 56. Ha (3)

Characteristics of Alloyed Cast Iron. F. W. SHIPLEY, *Transactions American Society for Steel Treating*, Vol. 19, No. 2, 1931, pages 165-181.

Discussion. Previously abstracted as Preprint No. 29, 1931. See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 31. WLC (3)

Magnetic Properties of Gold-Iron Alloys. J. W. SHIH. *Physical Review*, Vol. 38, Dec. 1931, pages 2051-2055.

The alloys of Au and Fe of different composition ranging from 0.07 to 10% Fe by weight have been studied. It was found that the alloys containing 0.1 to 5% Fe are paramagnetic. Their susceptibilities decrease with rising temperature in a characteristic way, but do not follow either Curie's law or Weiss' law exactly. The square root of the susceptibility increases linearly with the percentage of Fe atoms added. Thus the Au-Fe series does not show the same property as the Ni-Cu alloys whose susceptibility increases with temperature in certain ranges. The behavior of the Fe atoms in the alloy and some correlations between magnetic susceptibility, density and melting point are discussed. WAT (3)

Ferrous Alloys. W. P. SYKES. *Conference on Metals and Alloys, Case School of Applied Science*, Cleveland, Ohio, Nov. 1931, Paper No. 8, 7 pages. Mimeographed.

General discussion of atomic arrangement, structure and properties under heat-treatment and age-hardening, with special attention to the Fe-W alloys, including those with Mo or Co also. No illustrations are included with the mimeographed paper. These, shown as lantern slides in the presentation at the conference, are essential to a good understanding of the paper. HWG + Ha (3)

Steel Castings meet Requirements. *Foundry*, Vol. 59, Dec. 1, 1931, pages 58-59.

Castings to withstand pressure must be free from internal defects, and made from dense homogeneous metal. Soundness, density, and strength in steel castings is influenced by the deoxidation of molten metal. Research in steel castings production has made available a wide range of alloy steels and special heat treatments. Metal analysis and heat treatment control Brinell hardness. Steel which will withstand high pressures does not necessarily stand up at elevated temperatures. Steel castings of certain analyses have been found to meet these conditions successfully. VSP (3)

Measuring the Strength, Plasticity and Toughness of Tool Steels. J. V. Emmons (Cleveland Twist Drill Co.). *Iron Age,* Vol. 128, Dec. 24, 1931, pages 1614-1619.

From a paper presented before the American Society for Testing Materials in Chicago. Reviews previous investigations on mechanical properties of hardened tool steels. It considers various methods used for measuring such properties. A new method of measuring the properties of strength and plasticity in hardened steels, known as the torsion test, is described. From the measured properties of strength and plasticity, a value known as the coefficient of toughness is calculated. By this method, a study is made of the properties of a typical tool steel over a wide range of heat treatment. Conclusions are drawn as to the nature of the steel investigated. See "Some Physical Properties of Hardened Tool Steel," *Metals & Alloys,* Vol. 2, Oct. 1931, page 205. VSP (3)

Characteristics of Alloy Steels. III. Geo. M. Enos. *Modern Machine Shop,* Vol. 4, Feb. 1932, pages 26-30.

The troubles occurring often in heat-treating alloy steels are generally discussed, for instance too soft, soft spots, too hard, too brittle, warping, scaling, pitting; means of overcoming these are briefly treated. Ha (3)

Case-Hardening Steels. (Einsatzstähle.) E. Eichwald. *Automobiltechnische Zeitschrift,* Vol. 35, Feb. 10, 1932, pages 59-64.

This article deals with steels which have been given, by a suitable heat treatment, a uniformly fine structure, high tensile properties and a glass-hard surface. The German standardized steels (6) and 82 other products are listed and their physical properties, heat treatment and application described. Ha (3)

Weight of Hot Rolled and Cold Rolled Strip Steel. J. K. Olsen. *Metal Stampings,* Vol. 4, June 1931, page 528.

This table gives the weight in lbs./ft.² of hot rolled and cold rolled strip steel from 00000 Birmingham Gage (=0.500 in.) to 36 Birmingham Gage (=0.004 in.). Hot rolled steel weighs 487.3 lbs./ft.³ and cold rolled steel weighs 489.6 lbs./ft.³ JN (3)

A New Iron of German Origin. *Chemical Age,* London, Vol. 26, Metallurgical Section, Jan. 2, 1932, page 1.

A new special iron, called "migra iron" (abbreviated from micrographite) to mark its fine-fractured structure and its fine-grained graphite, is being manufactured by the Vereinigte Stahlwerke, Germany, and also, in a form poor in phosphorus, at the Friedrich-Wilhelm smelter in Muhlheim. Prof. Piwowarsky, of Aachen, reported on the use of this new iron for foundry purposes at the annual meeting of the Verein Deutscher Eisengiessereien, Berlin. The difficulty in its manufacture lies in a very definite intermediate heat treatment of the crude liquid Fe according to the principles of superheating melts. The total C and graphite content of the migra iron so obtained is lower, whereas the bending strength and Brinell hardness are higher. VVK (3)

Relation Between Magnetic Properties, Impact Strength and Hardness. H. Styri. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 94-106.

Includes discussion. See abstract of preprint. *Metals & Alloys,* Vol. 2, Oct. 1931, page 206. HWG (3)

The Common and Special Steels. (Gli Acciai Comuni e Speciali.) G. Guzzoni. Ulrico Hoepli, Milan, 1932. Paper, 6½ x 9½ inches, 471 pages. Price 60 lire.

The properties, structure, physical and mechanical properties, methods of testing, effects of impurities and gases, behavior in freezing, hot and cold working, and heat-treatment, of carbon steels are first discussed, then the common alloy steels, high speed and magnet steels, and the high Cr and 18-8 types. Carburizing and nitriding, and metallographic methods of identification of constituents and inclusions are also dealt with.

The treatment is remarkably up-to-date. Each section has a selected bibliography, comprising standard books, mostly recent ones, and a well-chosen list of periodical references of the vintage of 1927-1931. Guzzoni is very conversant with the important investigations of American, German, British and French metallurgists and has utilized the newer information in effective style. Probably more emphasis is put on Hanemann and Schrader's theories of martensite, and on "accelerated" methods of determining endurance limit and high temperature creep properties than they deserve. On the whole, however, the choice of material and the emphasis put on it is very good.

The volume is well printed and well indexed. On account of its being so up-to-the-minute, and its contents so well chosen, it is a very useful reference book even to those who read Italian with less facility than other languages in which metallurgical information is published. The quality of recent Italian metallurgical articles and treatises is so good that, if it is kept up, an English-speaking metallurgist will probably find a reading knowledge of Italian more useful than of any foreign language save German. H.W. Gillett (3) -B-

Hardness, Microstructure and Temperature Coefficient of the Electric Resistance of the Iron-Platinum-Alloys. (Härte, Mikrostruktur und Temperaturkoeffizient des elektrischen Widerstandes der Eisenplatin-Legierungen.) W. A. Nemilow. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 204, Feb. 9, 1932, pages 49-59.

All Fe-Pt alloys are magnetic at room temperature, with increasing content of Pt the magnetizability decreases. The method of making these alloys in the Krystol-furnace and in the oxy-hydrogen flame is described. The hardness curve is irregular with 2 maxima for the annealed alloys which points to the existence of 2 solid solutions at about 35-40 and 60-70% Pt. The microstructure shows a more or less definite pattern of straight lines. The curve of the temperature coefficient drops irregularly with the Pt-content and has 2 minima. 9 references. Ha (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Reactions with Liquid Chlorine. (Ueber Reaktionen mit flüssigem Chlor.) J. Meyer & W. Aulich. *Zeitschrift für angewandte Chemie,* Vol. 44, Jan. 1931, pages 21-23.

A number of metals were tested to determine their behavior in contact with liquid Cl at temperatures up to 140° C. Te and Se formed the tetrachloride at —80° C.; V shows a sudden violent reaction at room temperature. Gold is chlorinated completely at moderate temperatures, but with Ag, the film of silver chloride forms a certain protection against further chlorination; Pb also shows only a surface action. Cr and Mn react only if a little water is added. Si and crystalline B are very resistant. Ha (4)

The Evaluation of Production Corrosion Losses. Stanley Gill & Fred W. Karl (Gulf Oil Companies). *Proceedings American Petroleum Institute,* Dec. 1931, Section IV, pages 27-35. *Oil & Gas Journal,* Vol. 30, Nov. 12, 1931, pages 44, 138, 140, 142-144; *Oil Weekly,* Vol. 63, Nov. 20, 1931, pages 20-24, 25, 28, 30, 32, 34.

Up to the present time there has been developed no uniform system whereby the magnitude of the economic losses arising from corrosion of production equipment can be determined. The general principles which must be applied in evaluating losses resulting from corrosion of production equipment are discussed under the headings of direct loss of material, cost of repairs, loss of production, indirect increase in production corrosion, and other sources of corrosion loss such as water-flooding of producing formations due to corrosion. The fundamental formula from which formulae are derived for each specific type of corrosion is

$$\text{Actual loss of material} = \text{Depreciated value at time of failure} - \text{Scrap recovering value}$$

VVK (4)

The Theory of Metallic Corrosion in the Light of Quantitative Measurements. Part IV. G. D. Bengough, A. R. Lee & F. Wormwell. *Proceedings Royal Society,* London, Vol. 131, May 1, 1931, pages 494-517.

The factors which prevent the steady progress of corrosion are first, formation of insoluble substances which give a local protection, and second non-uniform supply of oxygen. Test results with potassium chloride and potassium sulphate solutions are communicated. Ha (4)

Corrosion of Iron. C. W. Borgmann. *Bell Laboratories Record,* Vol. 10, Mar. 1932, pages 230-232.

Brief description of corrosion as an electrochemical process. The nature of the corrosion product is important. Products that have a gel structure can absorb moisture so that the moisture is not "free" to act as an electrolyte. Beyond a certain critical relative humidity, 40% at normal temperature in the case of iron rust, the moisture is free and rapid attack occurs. It is suggested that the corrosion product on a Cu-bearing steel is of such nature that it takes a higher humidity to produce free moisture. Ha+HWG (4)

The Effect of Oxygen on Gaseous Hydrogen Sulphide Corrosion of Tank Steel. John M. Devine, C. J. Wilhelm & Ludwig Schmidt. *Report of Investigations* 3160, United States Bureau of Mines, Feb. 1932, 19 pages.

O_2 is necessary to cause corrosion. The O/H_2S ratio in the gas is the prime consideration in predicting the magnitude of the corrosion; with a ratio of approximately 114, the maximum corrosion was obtained. Gases of relatively low H_2S content are more active in producing corrosion in the presence of a small amount of O_2 than are gases containing a relatively large amount of H_2S. However, approximately 0.025% (16 grains/100 ft.³) H_2S is the lower limit for producing severe corrosion at atmospheric pressure. Corrosion proceeds proportionally with time; scale is non-protective. AHE (4)

The Velocity of Corrosion from the Electrochemical Standpoint. U. R. Evans, L. C. Bannister & S. C. Britton. *Proceedings of the Royal Society,* London, Vol. A131, 1931, pages 355-375.

It is shown experimentally that, under conditions favorable for the complete tapping of electric currents flowing between the anodic and cathodic portions of corroding metals, the currents measured are equivalent to the corrosion produced. This is true both when the anodic and cathodic areas consist of different metals, and when the whole system consists of one metal, the anodic and cathodic areas being determined by differences in oxygen concentration. Owing to polarization, anodic and cathodic potentials tend to equality as the current flowing increases. This sets a limit to the corrosion rate which cannot be exceeded. There is an approximation to "equi-potential conditions" at fairly high concentrations, but anodic and cathodic potentials differ considerably in dilute solutions, where owing to the low specific conductivity, an appreciable residual e.m.f. is necessary to force even the small corrosion current through the circuit. Experimental results must be interpreted with caution, that is, when the primary skin has only occasional weak points (as on stainless steel), or if the anodic surface becomes covered with an undissolved layer of the anodic product. In most cases, the polarization which limits the corrosion rate occurs at the cathodic area, and is due to limitations of oxygen supply. Cathodic polarization curves, under controlled conditions of oxygen supply, end at high potentials in a horizontal part, indicating the law governing the ratio of anodic and cathodic areas. When corrosion starts at a weak point in the invisible film covering the sur.ace of a metal, the area undergoing attack extends (or contracts) until the cathodic current density on the part remaining unattacked is equal to the "protective value"; the current flowing under these conditions defines the rate of corrosion. The "protective value" is the current density which will cause any incipient attack on a weak point to lead to the precipitation of rust sealing the defect. This principle is used in the cathodic method of corrosion prevention, and several other methods of protection depend on the same principle. WAT (4)

The Corrosion of Metals II. (In English). W. PALMAER. Svenska Bokhandelscentralen A-B, Stockholm, 1931. Paper, 6½ x 9¼ inches, 198 pages. Price $3.85.

This volume includes rather detailed descriptions of experiments carried on by Palmaer's students in 1920-1924, which relate to special cases. Later research of a more general nature was recorded in Part I. Part III, not yet published, is to deal with the special theory of the corrosion of iron.

The title is somewhat misleading, as practically all the experiments deal with the rate of solution of metals in acid or other active solvents and not with corrosive conditions under which the metals would have a useful life. The author considers that all the experiments support the opinion that the primary factor in corrosion is the activity of local galvanic elements. The experiments deal with malleable iron, soft iron, electrolytic iron, zinc, aluminum, etc.

There is a table of contents, but no index. The high spots of the various investigations are not well summarized and those who happen to be interested in the rate of solution of metals by acids will have to read the whole book to follow the argument. H. W. Gillett(4)-B-

Temporary Rust Preventers. E. C. J. MARSH & E. MILLS. *Aircraft Engineering,* Vol. 4, Mar. 1932, pages 57-62.

The protection of partly finished and completed ferrous metal parts against corrosion has been studied. Mild steels still possess many advantages over non-corrodible metals. After reviewing the various protective methods, the merits of various classes of grease and oils are considered in detail giving the results of a large number of experimental tests with analytical and tabulated data and some selected photographs showing the relative efficacy of the media tried. Alkalies, waxes, soap greases, soluble oils, and non-drying varnishes are to be avoided as protective agents except in those rare cases where special conditions suggest their obvious adoption. Mineral oils and jellies usually command priority. Where lubrication is also a requirement; for components flowing through machine shops; for components, initially thoroughly clean, to be stored under reasonably good conditions; for slushing machinery during shut downs; and for all cases where good protection is required but contamination of non-ferrous parts is possible—mineral products should always be selected. Lanoline products yield the best protection. They should always be considered for finished iron and steel articles where excellent protective qualities are desired but where lubricity is not paramount. Where storage conditions are bad, linseed oil offers an alternative to lanoline in the coating of metal parts awaiting finishing processes. WAT (4)

Corrosion Tests Proving Value of Coatings. FLOYD SWINDELL. *Oil Weekly,* Vol. 61, May 22, 1931, pages 29-30.

The present investigation of protective coatings for pipe lines resulted from recommendations of the sub-committee on production and pipe line corrosion of the A. P. I. in the chairman's report in 1928. This report describes the second test opened for inspection. (4)

Evaluation of Laboratory and Service Corrosion Tests. (Bewertung von Laboratoriums- und Naturrostversuchen.) K. DAEVES. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and the Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

Laboratory corrosion tests aim to determine, on a small scale and in a short time, the properties which are important for practical behavior. The general behavior of materials against corrosion attack cannot be established by laboratory tests, since the practical behavior depends less on the material than on the properties of the layers that are formed on the surface during corrosion. Corrosion tests in acids do not result in any conclusions as to the behavior in the atmosphere or in natural waters. Corrosion tests, therefore, should be performed under the actual conditions of application. GN (4)

The Nature and Causes of Dislodgment of Rust in Pipes. (Beschaffenheit und Ursachen der Rostablagerungen in Rohrleitungen.) K. BUNTE & P. STRUCK. *Das Gas- und Wasserfach,* Vol. 75, Jan. 1930, pages 87-89.

Tests were made to investigate the causes of rust which flaked off and clogged gas pipes. The oxygen content of the gas in the presence of condensed water has a direct effect on the kind of rust formed. Corrosion by steam is eliminated by drying the gas. When regeneration takes place, the addition of air must be very carefully regulated to prevent entrance of any oxygen into the gas. Washing the gas to remove impurities as well as hydrocarbons in the gas reduced the amount of rust. Gas cannot be purified satisfactorily as yet, but careful supervision of the purification system is very advantageous for lessening the formation of rust which flakes to clog the pipes. MAB (4)

Gas Plant Corrosion. B. G. DICK (Portland Gas & Coke Co.) *Gas Age-Record,* Vol. 68, Sept. 12, 1931, pages 381-386.

Part of Report of Committee on Plant Corrosion of the Pacific Coast Gas Association. So far there seems to be no concerted effort to reduce losses from corrosion in gas plants. Incomplete data that are now available cover only some of the more severe problems in corrosion; problems which the gas companies have from economic necessity been forced to combat scientifically. It is the opinion of the committee that a continuous comprehensive study of the causes and preventions of plant corrosion will be the logical procedure to follow if these corrosion losses are to be reduced to a minimum. Recent developments are discussed such as Cr and Cr-Ni steels, nitrided steels, the use of Al for oil storage tanks, paints and paint testing. Data on general corrosion problems and on accelerated paint testing is given in a report by the Central Arizona Light & Power Co. at Phoenix, Arizona. VVK (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Physics and Metallography of Magnesium. (Beiträge zur Physik und Metallographie des Magnesiums.) E. SCHMIDT. *Die Metallbörse,* Vol. 21, June 13, 1931, page 1110; July 25, 1931, page 1398.

Reviews a paper before the Deutsche Bunsengesellschaft für angewandte physikalische Chemie, Vienna, 1931, discussing the anisotropy of physical properties, aging and deformation phenomena and formation of solid solutions. The second review refers to a more recent paper before the Kaiser Wilhelm Institut für Metallforschung, Berlin, 1931, which reports experiments on physicals, plasticity and metallographic investigations on binary solid solutions of Mg. EF (5a)

The Equilibrium Diagram of Iron-manganese-carbon Alloys of Commercial Purity. E. C. BAIN, E. S. DAVENPORT & W. S. N. WARING (Research Lab. of the U. S. Steel Corp.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 467, Feb. 1932, 24 pages.

Alloys of commercial purity prepared in a 250-lb. arc furnace were used. They contained as much as 1.5% C and 15% Mn. All forged without difficulty. The portion of the equilibrium diagram representing transformations in the solid state was determined from a microscopic examination of the alloys as quenched from various temperatures. X-ray methods were also used, but they served only to confirm the results of microscopic examination. The phases austenite, ferrite and carbide were found. Mn was considered as replacing some Fe in the carbide phase as the Mn content increased. The epsilon phase was not considered to be stable at any temperature. Few data are given, but the results are shown in sections of the 3-dimensional diagram. 14 references. JLG (5a)

A Metallographic Investigation of Native Silver. H. C. H. CARPENTER & M. S. FISHER. *Bulletin Institution of Mining & Metallurgy* No. 330, March 1932, 22 pages; No. 331, Apr. 1932, pages 1-25; *Metal Industry,* London, Vol. 40, Mar. 25, 1932, pages 344, 349.

The authors, investigating 21 specimens of native Ag and Ag ores from 14 localities, found that Ag can recrystallize at ordinary temperature but that when it does so the recrystallization is incomplete and the structure of the metal does not become homogeneous. Native Ag is deposited by aqueous solutions of meteoric or juvenile origin. Supergene Ag and Ag deposited by cool hypogene solutions may have an unaltered structure free from any trace of recrystallization, or a partly recrystallized structure, but not a coarse homogeneous structure like that produced by annealing the metal. A structure of the latter type is characteristic of native Ag that has been formed by highly-heated hypogene solutions at a temperature above the normal recrystallization temperature of Ag, about 200° C. Native Ag from most localities has been deposited by meteoric waters or by cool hypogene solutions. At Excelsior Prospect (N. Rhodesia), at Lake Superior and in the Cobalt district of Ontario Ag has been deposited by hot juvenile solutions at a temperature above 200°. Contains 30 excellent microphotographs. PRK+AHE (5a)

Equilibrium Relations in Aluminum-copper-magnesium and Aluminum-copper-magnesium Silicide Alloys. E. H. DIX, JR., G. F. SAGER & B. P. SAGER (Aluminum Research Laboratories). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 472, Feb. 1932, 13 pages.

The effect of 0.5% Mg on the solid solubility of Cu in Al was investigated by microscopic methods. This quantity of Mg slightly decreased the solubility of Cu at all temperatures. The small decrease in solubility would hardly account for the effects of Mg in strong Al alloys. The influence of Mg in these alloys may be due to the effect that it exerts on the degree of dispersion of the $CuAl_2$ or the precipitation rate. The effect of 1.3% Mg_2Si on the temperatures and concentrations at which $CuAl_2$ is precipitated was found to be negligible. In these alloys, however, a new phase containing Al-Cu-Mg-Si is formed. The line along which this compound is formed is somewhat over 100° C. above the line along which $CuAl_2$ is formed. 15 references. JLG (5a)

Multiple Systems with Iron, IV. The System Cr-C (and Fe-Cr-C). (Ueber Mehrstoffsysteme mit Eisen, IV. Das System Cr-C (and Fe-Cr-C). E. FRIEMANN, F. SAUERWALD & A. WINTRICH. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 203, Dec. 30, 1931, pages 64-74.

The equilibrium diagrams were determined and discussed; it is found that a stable and a metastable system co-exist. Carbides exist in several modifications, Cr_3C_2, Cr_7C_3, and Cr_4C; they differ by the degrees of hardness and can be distinguished by relief polish. The solubility of C in solid Cr is apparently smaller than 0.03%. 13 references. Ha (5a)

Equilibrium Relations in Aluminum-cobalt Alloys of High Purity. WILLIAM L. FINK & H. R. FRECHE (Aluminum Research Laboratories). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 473, Feb. 1932, 10 pages.

According to Gwyer, a eutectic is formed at the Al end of the diagram between Al and Co_3Al_{13}. Analyses of the compound obtained as a residue indicated that it corresponded to composition Co_2Al_9. The eutectic concentration appeared to be 1.45% Co as judged by microscopic examination, but extrapolation of freezing point data indicated that it was 1.0% Co. The solid solubility of Co in Al at just below the eutectic temperature was found to be less than 0.02%. The liquidus between the eutectic and the compound was determined by analyzing the liquor in equilibrium with Co_2Al_9 at various temperatures. The eutectic temperature was found to be 657° C. The diagram up to 8% Co is given. 11 references. JLG (5a)

Antifriction Alloys of Sn, Pb, Cu and Sb Rich in Tin. (Sur les alliages antifrictions Sn, Pb, Cu, Sb riches en étain.) M. FOURNIER. *Revue de Métallurgie,* Vol. 29, Feb. 1932, pages 101-107.

36 alloys containing a maximum of 12% Sb, 6% Pb and 6% Cu were studied microscopically and by hardness determination both in slowly cooled and chill cast state. Cu besides supplying a hard constituent Sn-Cu acts as a stabilizer permitting the formation of a homogenous alloy after a reasonably slow cooling. Under the microscope Sb can be estimated when higher than 8%, Cu fairly well but Pb not at all. JDG (5a)

Structure & X-Ray Analysis (5b)

A Precision Method of Measuring Small Changes of Lattice Spacings of Metal Single Crystals. RUDOLF C. HERGENROTHER. *Physics,* Vol. 2, Feb. 1932, pages 63-69.

A method of studying the progressive crystal lattice changes occurring in a series of alloys or mixed crystals is described. This method compares the Bragg angles of X-ray reflection from standard crystals with those of the crystal being studied. The important features of the method are simplicity and high accuracy (0.002%), which is attained without the use of an accurately calibrated angle scale. The theory of the method is discussed and two examples of experimental data which have been obtained are given. WAT (5b)

The Cathode Ray Effect Connected with X-ray-Spectroscopic Analysis. (Ueber den bei roentgenspektroskopischen Analyse auftretenden Kathoden-strahleneffekt.) M. ISHIBASHI. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 202, Dec. 24, 1931, pages 372-374.

The author describes the change which a composition of Ti oxide, Ba sulphate and Fe oxide undergoes when subjected to analysis by cathode rays. The intensity of certain lines is increased. A number of measurements on meteorites are described. Ha (5b)

Corrosion Structure, Corrosion Mechanism and the Tamman Resistance Limits. X-ray Examination of Gold Copper Single Crystals. (Korrosionsgefüge, Korrosionsmechanismus und die Tammann'schen Resistenzgrenzen. Röntgenographische Untersuchung an Gold-Kupfer-Einkristallen.) L. GRAF. *Metallwirtschaft,* Vol. 11, Feb. 5, 1932, pages 77-82; Feb. 12, 1932, pages 91-96.

Contains 14 references. Au-Cu alloys consisting of single crystals were etched with various reagents which attack Cu but not Au, and the surface of the alloys was then examined by means of X-rays to determine its composition and structure. The liberated Au atoms, which are not attacked by the reagents, combine to form a thin new layer on the surface of the alloy with the same crystallographic orientation as that of the Au-Cu single crystal. Strongly oxidizing reagents such as HNO_3, H_2CrO_4 and $HMnO_4$ produce a layer of pure Au without any intermediate zone. Weakly oxidizing reagents, alcoholic picric acid, sulphur compounds, such as $(NH_4)_xS$ and Na_2S, and gases at ordinary temperatures produce a Au rich alloy of variable Cu content. At elevated temperatures, above 200°C., where atomic diffusion takes place, gases produce a pure Au surface layer which gradually changes to the alloy structure. Aqua regia, which attacks both Cu and Au, produces a pure Au surface while KCN-H_2O_2 solution forms an alloy structure. The theory of the formation of the surface layer is discussed at length. There are 3 possible ways: directly, through the lattice forces, or indirectly, through diffusion or ionization. Under the action of strongly oxidizing reagents, including aqua regia, both Au and Cu atoms on the surface become ionized. The Au atoms leave their position in the lattice and exchange places with neutral Cu atoms, transferring their charges to the Cu atoms when they reenter the lattice, until a surface of pure Au is formed. Under the action of gases at ordinary temperatures and other solutions the Cu atoms only become ionized and are removed from the lattice. The exposed neutral Au atoms remaining in the lattice rearrange themselves due to their lattice forces. A small number of Cu atoms are trapped in the rearranged structure, forming a surface alloy rich in Au and with variable Cu content. During gas attack at elevated temperatures the mobility of atoms due to diffusion outweighs the lattice forces and no Cu atoms become trapped in the surface layer. This theory is used to explain the limits of resistance to chemical attack, described by Tamman. Reagents which form an Au rich surface alloy attack alloys containing up to 25 atomic % Au. Due to the uni-dimensional mobility of the atoms one Au atom is enough to block the attack on a whole chain of atoms. Strongly oxidizing reagents attack up to 50 atomic % Au alloys, as the ionized atoms have tri-dimensional mobility and it requires 2 Au atoms to prevent attack by the reagent. CEM (5b)

X-Ray Research in Metallurgical Science. (Röntgenforschung in der Metallkunde.) Vol. 10 of Ergebnisse der Exakten Naturwissenschaften. ULRICH DEHLINGER. Julius Springer Verlag, Berlin, 1931. Paper, 6 x 9½ inches, 386 pages. Price 37.60 RM.

This paper appearing in one of the annual volumes of a series relating to progress of science has also been published as a separate monograph. The author is well known for his investigations in the field of the structure of metals and alloys, especially as regards the theory of deformation. The subject matter is divided into two parts; the first, researches on states which are in thermodynamic equilibrium, including structures and properties of elementary metals, solid solutions, over-structures and eutectics, and intermetallic compounds; and second, states which are not in thermodynamic equilibrium, including intermediate states of metallic transformations, growth structures, corrosion and deformation mechanism, and recrystallization texture.

The material is presented, of course, in very condensed form but some of the topics are of particular value, inasmuch as they are little known in other books dealing with X-ray methods. Among these are the treatment of the total and free energies of transformations such as body-centered and face-centered cubic iron, over-structures—that curious alloy behavior indicated by the appearance of new lines in the diffraction patterns, structure of the properties of marcasite, aging of metals and alloys, and the mechanism of deformation such as has been presented in several papers by the author. The whole exposition stresses the theoretical side and thus the monograph forms a valuable addition to more detailed descriptive results in the field of metallurgy available in several textbooks. It is to be hoped that the author will bring the material up to date yearly or expand the topics here treated into a book. George L. Clark (5b)-B-

Experiments on the Emission and Absorption of Radiation by Metallic Silver. F. L. MOHLER. *Bureau of Standards Journal of Research,* Research Paper 421, Vol. 8, Mar. 1932, pages 357-364.

The emission spectrum of Ag bombarded by electrons is characterized by a high intensity from the visible to 3600 A. U., with a decrease to a very low value beyond 3200 A. U. The spectrum emitted by Ag bombarded by 100-volt electrons in high vacuum is similar to the emission of a Ag probe surface at a low positive potential in a caesium discharge. Probe emission spectra at different temperatures have been compared and a small effect found which may or may not be a pure temperature effect. The slope between 3600 A. U. and 3200 A. U. becomes slightly less with a shift toward longer wave length with increasing temperature. The absorption of a silvered quartz plate has been measured at temperatures between 20° and 490° K. There is a large increase in absorption with increasing temperature limited to the range 3350 to 2950 A. U. with a maximum effect at 3100 A. U. The effect is a decrease in slope of the violet edge of the selective transmission band with increasing temperature. The results are contrary to a theory proposed by Boeckner and the author. The observed change in emission is less and in absorption much greater than the predicted effect. WAT (5b)

An X-Ray Investigation of Some Copper-Aluminum Alloys. G. D. PRESTON (National Physical Laboratory). *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Series 7, Vol. 12, Nov. 1931, pages 980-993.

Gives results of an investigation dealing with that part of the Cu-Al system containing 31-50 atomic % Al. The lower limit coincides with the boundary of the γ phase. This investigation shows that the cubic γ phase has a homogeneity range extending from 31 to 35.5 atomic % Al. Above this, a hexagonal phase exists in the neighborhood of 43 atomic % Al and then by an orthorhombic phase which is probably CuAl. The hexagonal phase exists over an extended range of temperature and probably exists at room temperature. The orthorhombic exists at about 600° C. but probably undergoes transformation at room temperatures. Some general deductions tend to support the theory advanced by W. Rosenhain concerning the nature of intermetallic compounds. Rosenhain's theory is that neighboring phases in a constitutional diagram might arise from definite molecular groups of atoms held together by other atoms, the range of existence (in concentration) of the phase being supposed to be due to the possibility of replacing the binding atoms by atoms of either element while the "molecule" or group remained unchanged from phase to phase. RHP (5b)

Research on Primary Crystallization. (Beiträge zur Frage der Primärkristallisation.) F. RAPATZ. *Stahl und Eisen,* Vol. 52, Feb. 18, 1932, pages 171-172.

Discussion of Hensel, Tammann and Leitner's research studies on primary crystallization. Variables considered are composition of alloys, casting temperature, rate of casting, type of mold and mold preheating, with their separate effect on amount of primary, secondary, and tertiary crystallization zones, transcrystallization, and crystal size. 2 types of materials were stressed: (1) high Sn alloys, and (2) 3 to 4% Si steels. DTR (5b)

The Present Status of Possibilities of Diascopic X-Ray Tests. (Der gegenwartige Stand Röntgendiaskopischer Prüfungsmöglichkeiten.) H. REININGER. *Werkstattstechnik,* Vol. 25, May 1, 1931, pages 225-230.

The principle of translucency for X-rays are discussed and apparatus for this simplest method of X-ray testing in the shop described. A list of 30 references is added. Ha (5b)

New Calibration Method for Precise Determination of Lattice Constants of Poly-crystalline Material. (Neue Eichungsmethode zur Präzisionsbestimmung von Gitterkonstanten an polykristallinen Materialien.) F. REGLER. *Physikalische Zeitschrift,* Vol. 32, Sept. 1, 1931, pages 680-687.

Deviations from the true value of space lattice constants were noticed on polycrystalline material investigated by the Debye-Scherrer-Hull method. In spite of taking into account the Harding correction, increasing values of space lattice constants were measured with increasing reflection angles and with constant dimensions of the sample on one hand and a steady increase of the mean value of the space lattice-constants was obtained with increasing sizes of 2 g of the sample on the other hand. Therefore Regler set forth to quantitatively study the sources of trouble in order to eliminate errors in future measurements. The corrections which must be taken into account in addition to the Harding correction are graphically presented. The investigator employed an X-ray tube of 20 kv, 10^{-2} Amp, provided with an Fe anticathode and Lindemann window and used the K_α radiation of Fe. EF (5b)

X-Ray Crystal Analysis. G. CADOGAN ROTHERY. *Electrical Review,* Vol. 110, Jan. 8, 1932, page 48.

Review of a report issued by an X-Ray Committee under the chairmanship of Sir William Bragg, appointed by the Department of Scientific and Industrial Research. One of the problems investigated was the "spoiling" and recovery of W magnet steels. These steels show a serious drop in coercive force after heat treatment between 900° and 1000° C. but recover their magnetic quality after a brief reheating at 1250° C. Before hardening and magnetizing, W steel gives an X-ray pattern with lines of α-iron. After treating at 900° C., the pattern contains new lines due to formation of tungsten carbide, WC, and a mixed carbide of tungsten and iron, $Fe_4 W_2C$. The carbide lines disappear on reheating at 1250° C. If the steels are H_2O quenched at 850° C. or lower, after heating at 1250° C., the carbide lines will appear. Annealing at 1250°, 1150°, 1025° and 900° C. resulted in the appearance of the carbide lines at 1150°, the $Fe_4 W_2C$ lines increasing continuously as the temperature fell. The X-ray method has been applied to the study of electrolytic deposits of metals. Investigation showed distinct selective crystal orientation, the degree of orientation depending upon current density and the nature of the electrolyte. MS (5b)

The Intensities of Interferences Produced by Rapid Cathode Rays and a Suitable Apparatus for Demonstration Purposes. (Ueber die Intensitäten der Interferenzen von schnellen Kathodenstrahlen und Vorführung eines einfachen Interferenzapparates für Demonstrationszwecke.) F. KIRCHNER. *Physikalische Zeitschrift*, Vol. 32, Dec. 15, 1931, pages 969-971.

The utilization of X-rays for the investigation of crystal powders is compared with the application of cathode rays. Experiments on poly-crystalline material and single crystals are discussed and a simple interference apparatus is demonstrated at the 7th Deutscher Physiker und Mathematikertag, Bad Elster, Sept. 1931. EF (5b)

An X-ray Study of the Nature of Solid Solutions. ROBERT T. PHELPS & WHEELER P. DAVEY (Pennsylvania State College). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 443, Feb. 1932, 14 pages.

Ag-rich alloys containing as much as 9% Al were prepared from metals of high purity. Their lattice dimensions were determined by X-ray diffraction methods, where the patterns were compared with NaCl. Densities were obtained by weighing in air and alcohol. The samples were heat treated in order to promote homogeneity. From the diffraction patterns, it was evident that about 5.4% Al was soluble in solid Ag. Further additions of Al gave aggregates of Ag_3Al. The densities as calculated from lattice parameters and as determined by weighing were the same for pure Ag, but as Al was added the density determined by weighing was less than the calculated value. The difference between the 2 values increased with increasing Al. From considerations of the possible arrangements of atoms in crystals, it was concluded that the Al atoms could not be replacing the Ag atoms, but the Al in solution was chemically combined with the Ag. In this case, there are units of structure of lower density, which are not sufficiently abundant to form a diffraction pattern. This picture was not found to be inconsistent with any of the known properties of solid solutions. 25 references. JLG (5b)

An X-Ray Determination of Crystal Orientation in Nickel, Copper and Aluminum, Produced by Cold Rolling. C. B. HOLLABAUGH & W. P. DAVEY. *Physical Review*, Vol. 37, June 15, 1931, pages 1697-1698.

High purity Ni, Cu and Al, free from all preferred orientation, were cold rolled in such a way as to produce no appreciable temperature rise and the orientations were determined after each pass. Ni and Cu showed identical orientations both as to limits of ranges of preferred orientations and mean positions. The number of passes through the rolls determines the probability that a crystal fragment will be within the preferred range. Al shows a related preferred orientation, but with widely different angular limits which depend on the number of passes through the rolls. This work shows, contrary to the accepted belief, that except for Cu and Ni, the common face-centered cubic metals show differences in preferred orientation, both with respect to the limits of preferred range and with respect to the mean position of orientation. WAT (5b)

On the Question of Slip in Crystalline Structure during Rolling. S. T. KONOBEEVSKY. *Zhurnal Prikladnoi Fiziki* (*Journal of Applied Physics*), Vol. 4, No. 3, 1927, pages 1-8.

Al is found to possess 2 different types of structure, depending on the degree of working. One is obtained as the result of light rolling and possesses an axis in the plane of a rhombic dodecahedron, between the directions (111) and (211), somewhat nearer to the latter. The other, produced by heavy rolling, has an axis the indices of which are (110), while the upper surface of the plate is in the plane parallel to the cube (100). No transitional stages between the 2 types can be detected, although the presence of both may be observed quite clearly on a rolled plate. An explanation of the formation of the 2 types is given. WHB (5b)

A Heating Arrangement for X-Ray Samples (Ueber eine Heizvorrichtung für Röntgenpräparate). G. WASSERMANN. *Metallwirtschaft*, Vol. 10, Dec. 4, 1931, pages 922-923.

Disadvantages of other methods are overcome by heating the sample in the stream of an inert gas which has been heated outside of the X-ray apparatus. The sample is mounted vertically in a small porcelain tube and the gas flows from a cylinder through a furnace and then through a short movable glass tube at right angles to the sample. On the opposite side of the sample, another glass tube of larger diameter is mounted through which the gas is removed by suction. The distance of the 2 glass tubes from the sample can be closely adjusted. The thermocouple for determining the temperature of the sample is placed in the exit tube. Advantages of this method are accessibility of the sample by moving the glass tubes, adjustment of the temperature by varying the gas pressure and accuracy of temperature measurement. CEM (5b)

The Chemistry of Alloys. (Zur Chemie der Legierungen). A. WESTGREN. *Zeitschrift für angewandte Chemie*, Vol. 45, Jan. 9, 1932, pages 33-40.

After discussing the variability of the composition of alloy phases, the author deals with the determination of the formulas of metallic phases from their atomic arrangements, quoting as examples measurements which have resulted in arriving at the compositions of the β-phase of the Cu-Zn system, of $FeSi_2$ and other intermetallic compounds. A discussion follows of the similarity of the powder photograms of such intermetallic compounds as Ag_3Al and Cu_5Si to that of β-Mn. The author concludes that consideration of the results presented leads inevitably to the view that a new definition for what may be termed the ideal intermetallic compound must be formulated. Attention is then directed to the recurrence of similar structural types in the alloys of Cu, Ag, and Au, reference being made to Hume-Rothery's observations regarding the relationship between the valence-electrons and the atoms in certain phases of these systems. Regularities in the structures of the alloys of the transition elements are made the subject of comment, the paper in closing emphasizing the value of X-rays in deciding the character of the various alloys which are met with. OWE (5b)

Graphical and Mechanical Evaluation of Debye-Scherrer Photograms of Cubic, Tetragonal, Hexagonal or Orthorhombic Symmetry, including the following Examples: WC, PdF_2 and $HgCl_2$. (Graphische bezw. maschinelle Auswertung von Debye-Scherrer Diagrammen kubischer, tetragonaler, hexagonaler und rhombischer Symetrie mit Anwendungsbeispielen: WC, PdF_2 und $HgCl_2$.) E. Ebert (Technische Hochschule Breslau) *Zeitschrift für Kristallographie,* Vol. 78, July 1931, pages 489-495.

A simple evaluation method of Debye-Scherrer photograms is mathematically derived which, in contrast with the Hull-Davey charts, permits the use of straight lines due to a decomposition of the quadratic forms. A possibility of a mechanical evaluation method of Debye-Scherrer photograms is indicated and the description of the completed apparatus is announced. The utilization of the graphical evaluation method is demonstrated by means of the following representative compounds: WC (hexagonal), PdF_2 (tetragonal) and $HgCl_2$ (ortho-rhombic). EF (5b)

Equilibrium Relations in Aluminum-zinc Alloys of High Purity. William L. Fink & Kent R. Van Horn (Aluminum Research Laboratories). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 474, Feb. 1932, 11 pages.

Hardness, conductivity measurements and microscopic examination were not found to be satisfactory for locating the solid solubility limit of Zn in Al. This limit was therefore determined by use of X-rays, where powder patterns were obtained from filings at temperatures up to 250 °C. The solubility limit was determined from the presence of diffraction lines from the Zn phase, a correction being applied for the amount of Zn that would just fail to produce visible lines (0.5%). The solubility of Zn in Al was found to be:

Temperature °C	Zn %
25	2.7
100	5.2
150	7.4
200	9.4
250	13.4

19 references. JLG (5b)

The Structure of Rolled Zinc and Magnesium (Die Walztextur von Zink und Magnesium). V. Cagliotti & G. Sachs. *Metallwirtschaft,* Vol. 11, Jan. 1, 1932, pages 1-4.

Contains 20 references. X-ray diffraction patterns were obtained for several samples of hot rolled sheet Zn and Mg, with the X-rays impinging in 10 different directions. The Zn photograms have the same appearance as those previously published in the literature. The pole figures show preferred orientation not only for the base but also for the pyramid. The Mg photograms differ according to the initial rolling temperature. The base ring is blackened near the equator in every case but the other diffraction rings of sheets rolled at 300° C. and under are blackened evenly. Rolled at 550° C., they show 6 sharp concentrations of intensity. The pole figures show distinctly outlined areas of concentration. The only difference between the structure of Zn and Mg is that in Zn the strongest concentration of the base surface is not in the rolling plane but at an angle of about 30° to the rolling direction, forwards and backwards, and about 25° to the rolling plane. The samples were also annealed at 200°, 400° and 600° C. The recrystallization structure is practically the same as the rolled structure. CEM (5b)

Report of the Abstract Committee. Abstracting Schemes for X-Ray Determinations of (I) Single Substances and (II) Series of Substances. (English) J. D. Bernal, P. P. Ewald & Ch. Mauguin. *Zeitschrift für Kristallographie,* Vol. 79, July 1931, pages 495-530.

The account of the abstract form proposed by a special committee appointed to consider the preparation of a standard sheet for abstracting structural papers. EF (5b)

A Simple Ray- and High-Voltage-Proof Apparatus for Structure Pictures. (Ein einfacher strahlen-und hochspannungssicherer Apparat für Strukturaufnahmen.) A. Bouwers & W. Busse. *Zeitschrift für Kristallographie,* Vol. 177, May/June 1931, pages 507-514.

The X-ray tube is grounded in the center so that the preparation can be placed closer to the focus of the tube on account of the reduced voltage, and the time of exposure is greatly shortened. Ha (5b)

Precision Determination of the Dimensions of Crystal Space Lattices. (Präzisionsbestimmung der Dimensionen von Kristallgittern.) N. H. Kolkmeijer & A. L. Th. Moesveld (Van't Hoff Laboratory, Utrecht) *Zeitschrift für Kristallographie,* Vol. 80, Sept. 1931, pages 63-90.

Directing the attention to the various sources of errors involved in space lattice determinations by the use of the powder method, the authors set forth to convert this X-ray method into a precision measurement. The improvements on the Debye--Scherrer camera and the subsequent evaluation refer to (a) the insertion of the film, (b) centering of the sample, (c) the photographic operation, (d) outmeasuring technique, (I) evaluation, (II) checking, (III) correction for shrinkage (IV) corrections for the thickness of the sample, divergency of the beam and eccentricity of the testing sample (V) further calculations. The second part of the paper demonstrates the advantageous utilization of the writer's suggestions based on an investigation on rock salt, showing that the improvements lead to a "precision method of determination." EF (5b)

A Preliminary Report on a New Method of X-Ray Powder Diffraction. T. M. Hahn. *Physical Review,* Vol. 37, 1931, page 475.

A preliminary report on a method employing the use of a conical beam of X-rays incident upon powdered crystals arranged in a circular form about the central axis of the cone, normal to the axis. All rays diffracted through an angle θ will be brought together at a common point on the axis of the cone. A photographic film along this axis receives the record of the diffraction pattern, from which the spacing of the planes of the crystal may be determined. Advantages of this method are reduced time of exposure and an increased separation of diffraction spots. WAT (5b)

Radiation from Probe Surfaces Bombarded by Electrons. F. L. Mohler & C. Boeckner. *Bureau of Standards Journal of Research,* Vol. 7, Oct. 1931, pages 751-764.

Metals in the form of small probe surfaces are held at a positive potential in the highly ionized region of a discharge (commonly a cæsium discharge) and under intense electron bombardment emit radiation. Photographic spectro-photometric measurements are made. Radiations at 7 volts from W, Al, Be, Au alloyed with Cs, Th, and Pt are similar in intensity and intensity distribution. The spectral energy distribution on a wave-length scale is nearly constant between 6,400 and 2,400 A. U. with a radiation flux of about 20 ergs for a wave-length range of 1μ and for a current density of 1 ampere/cm². J (λ) for Cu has a pronounced increase in the red and for silver a tenfold increase between 3,200 and 3,600 A. U. Above 6 volts this intensity distribution remains the same while with lower voltages it drops almost linearly to zero with increasing ν. The threshold value of ν agrees with the relation $h\nu = e(V+W)$ where W is 1.45 volts for tungsten and about 2 volts for Cu, Ag, and Al. The voltage variation of intensity is different for each metal. The intensity and intensity distribution of tungsten and silver radiation in a helium discharge are similar to values obtained in cæsium vapor. The equal energy spectrum common to all metals is probably analogous to continuous X-rays. The selective radiation of silver and copper may correspond to characteristic X radiation. The high-frequency edge of the silver emission band has the shape of a Fermi distribution of electrons at 370° C., suggesting that the emission process involves the ionization of an underlying level and the fall of a conduction electron into that level. WAT (5b)

Theoretical Studies on the Structure of Twins. (Strukturtheoretische Studien über Zwillinge.) G. Aminoff & B. Broome (States Museum of Stockholm). *Zeitschrift für Kristallographie,* Vol. 80, Nov. 1931, pages 355-376.

The theoretical discussion pertains to ZnS, C (diamond), Au and PbS. EF (5b)

The Nature of Electron Movements in Crystals and Its Bearing on the Electrical Properties of Solids. (Über die Natur der Elektronenbewegung in Kristallen und ihre Bedeutung für das elektrische Verhalten der festen Körper.) Lothar Nordheim. *Metallwirtschaft,* Vol. 11, Feb. 26, 1932, pages 121-124; Mar. 4, pages 135-138.

Contains 9 references. A theoretical discussion on the relationship between the atomic structure and the difference between conductors, semi-conductors and insulators, deflection of electrons, X-ray absorption patterns and the Hall effect. For details the original article must be read. CEM (5b)

Space Lattice Constants for 1931. (Gitterkonstanten 1931). M. C. Neuburger. *Zeitschrift für Kristallographie,* Vol. 80, Sept. 1931, pages 103-131.

In a dozen tables Neuburger compiles the most ascertained data on the length of unit cell of elements, their crystal structure, atomic weight density (determined by X-rays) atomic radius, atomic space and atomic volume. 65 references. EF (5b)

Structure of Cold-drawn Tubing. John T. Norton & R. E. Hiller (Mass. Inst. of Technology.). *American Institute of Mining & Metallurgical Engineers, Technical Publication* No. 448, Feb. 1932, 14 pages.

The orientation produced in metals by various types of cold work is discussed. Orientation in low-carbon steel tubing was studied by the monochromatic pin-hole method. Orientations in steel sheet and wire were also determined as checks on the study of tubing. Conforming other investigators, a [110] direction tends to come in alignment with the axis of the wire, while in sheet a (110) plane becomes parallel to the direction of rolling and at right angles to the plane of the sheet with a second set of (110) planes at right angles both to the direction of rolling and the plane of the sheet. In tubing, the structure was intermediate between that of sheet and wire. With a reduction in wall thickness alone the structure conformed to that of sheet, while with equal reductions of wall and diameter the structure was that observed in wire. Samples worked by several methods to the same reduction gave similar structures, thereby indicating that orientation of the crystals was a function of the relative reductions and not of the manner of working. It was concluded that in processes which allow a greater reduction without annealing or produce a more ductile material, such as rolling on some of the 4-high mills, produce similar structures in the metal and that the better properties can be due only to the improved surface. 2 references. JLG (5b)

The Trend of X-Ray Analysis in Metallurgy. L. Pickup. *Metallurgia,* Vol. 5, Mar. 1932, pages 177-179.

Discussion of crystal structure of metals and alloys as determined by X-ray diffraction. Gives methods of analysis and discusses recent results. JLG (5b)

X-Rays in Engineering Practice. V. E. Pullin. *Proceedings Institution Mechanical Engineers,* Vol. 2, Pt. 2, Dec. 1930, pages 1133-1157.

With discussion. The application of radiology in the examination of castings, forgings, structures, etc., to show flaws and lack of homogeneity is surveyed. Many examples are shown in photographs. The methods of producing X-rays; the power of penetration and absorption in materials are explained. Ha (5b)

Atomic Influential Spheres with Tetraeder-Symmetry as a Common Element in Structure of All Crystal Space Lattices. (Atomare Wirkungsbereiche mit Tetraeder-symetrie als gemeinsames Bauelement der sämtlichen Kristallgitter.) R. Reinicke. *Zeitschrift für Kristallographie,* Vol. 78, June 1931, pages 334-362.

The author figured out a new classification of crystal systems based on tetraeder-symmetry and defines the following groups: Mg type: Be, Mg, Zn, Cd. Wurzit type: BeO, MgTe, ZnO, CdS, CdSe. Cu type (face centered cubic lattice): Cu, Ag, Au, Ca, Al, Ce-α, Th, Pb, Fe-γ, Co-α, Ni, Rh, Pd, Ir, Pt. EF (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Tests of Cast Iron (Les essais des fontes, considérations basées sur les résultats de différents essais et particulierement sur les essais faits en Tchécoslovaquie). M. F. Pisek. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 751-761, 13 figures; *Revue de Métallurgie,* Vol. 28, May 1931, pages 280-281.

Comparison on 12 irons, of different transverse and tensile test bars and of various shear tests. Best agreement was found in shear tests, next in tensile tests and the poorest in transverse. Frequency curves are plotted. (See discussion below). HWG+JDG (6)

Control of Cast Iron by the Shear Test (Du controle des moulages au moyen de l'essai au cisaillement). *Commission Scientifique de l'Association Technique de Fonderie de Belgique, Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 725-727; *Revue de Métallurgie,* Vol. 28, May 1931, pages 276-279.

A coöperative study of the behavior of small shear test specimens cut from iron castings of various cross sections in comparison with that of specimens cut from projecting coupons. The results were very erratic. The committee states that the results are interesting, but that while shear tests may sometimes come in as an acceptance test, it will have to have more study before it would serve for that purpose. (See discussion below.) HWG+JDG (6)

New Machine for Testing Small Cast Iron Specimens in Bending in Shear, and for Hardness (Nouvelle machine pour les essais des fontes sur petites eprouvettes (flexion-cisaillement-dureté). H. Thyssen & J. Bourdouxhe. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 729-733. 7 figures; *Revue de Métallurgie,* Vol. 28, May 1931, page 281.

One machine is provided with attachments for the tests named. The distance between supports in the transverse test is only 50 mm. (2"). The article is purely a description of the machine and does not deal with the relative results of tests on large and small specimens. (See discussion below). JDG+HWG (6)

Mechanical Tests of Cast Iron (Contribution aux recherches sur les essais méchaniques des fontes). H. Thyssen. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 735-740; *Revue de Métallurgie,* Vol. 28, May 1931, page 280.

Co-operative tests are recorded, comparing large and small transverse test bars, various shear tests, hardness and impact tests on a series of irons. An attempt was made to correlate the results with the compositions of the irons. No condemnation of any type of test nor conclusion that any one failed to give information was considered to be justified. The effect of Si and Mn on mechanical properties is overshadowed by the effect of the combined and graphite carbon. (See discussion below). HWG+JDG (6)

A Punching Shear Test for Control of Iron Castings (L'essai de cisaillement par poinconnage appliqué au controle des moulages de fonte). A. Deleuse. *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 741-749; *Revue de Métallurgie,* Vol. 28, May 1931, page 280.

A slice of cast iron 3 mm. (0.12 in.) thick is put in a punch and die operated on a testing machine (details of punch and die size not stated) and the force required to shear out a disk measured. Results of this test are compared with those of tensile, transverse, and Fremont shear tests on 9 different alloy cast irons. The punching test was about as consistent as any other test. (See discussion below.) HWG+JDG (6)

Discussion—Methods of Testing Cast Iron (La méthode d'essais des fontes). *Congrès International des Mines, de la Métallurgie et de la Géologie appliquée, Section de Métallurgie,* 6th session, Liege, June 1930, pages 765-772.

Discussion dealt chiefly with the shear test. Several reported satisfactory experience with it while others thought it gave no useful information, and doubted whether it measured any important engineering property. There appeared to be general agreement that the details of any shear test should be precisely defined and standardized and that, while the utility of the test in its present stage of development was not yet established, the test deserved much further attention. HWG (6)

A Simple Hardness Tester (Ein einfacher Härteprüfer). Huetter. *Oberflächentechnik,* Vol. 9, Jan. 5, 1932, pages 2-3.

The instrument tests the hardness of a galvanic deposit by a scratch with a glass-hard steel point or diamond point under which the sample is pulled along. The point is pressed against the sample with 50 g., 100 g. or more according to the material. The width of the scratch is determined in 1/1000 mm. and serves as measure for the hardness. Although very simple, the instrument gives consistent results, for instance, for the same pressure it was measured on

rolled lead	144 µ
rolled tin	76
duralumin, hard	56
copper sheet, hard	48
hard rolled brass	36
nickel sheet	34

The hardening effect of Co in Ni deposits could be easily measured, the value of 34 went down to 20 at 75% Ni and remained constant to 100% Co. Ha (6)

The Measurement of Large Brinell Impressions in Steel Rails. H. H. Morgan & J. R. Mooney. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 2, 1931, pages 118-128.

Includes discussion. See abstract of preprint. *Metals & Alloys,* Vol. 2, Nov. 1931, page 255. HWG (6)

A Contribution to the Studies of Methods for the Control of Foundry Products. Pierre Nicolau. *Transactions & Bulletin American Foundrymen's Association,* Vol. 5, Jan. 1932, pages 661-717.

A short history of the development of testing methods used in the past as well as those common today is given. The French have and still favor the Fremont shear test for determining heterogeneity and properties of castings, and Nicolau lends considerable support to the Fremont test through illustrations. A bibliography of 66 references to French contributions to the study of testing methods of cast iron concludes the paper. CHL (6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Fatigue Testing of Wire. S. M. SHELTON. *Proceedings American Society for Testing Materials,* Vol. 31, Part 2, 1931, pages 204-220.

The preparation of specimens for endurance testing is costly. It is difficult to machine and test specimens of small diameter. Local stresses at the grips cause fracture there when a short specimen of un-reduced section is tested. To avoid these difficulties in the testing of 0.19" diameter wire, the bearings of a R. R. Moore endurance machine were separated to take specimens 66 in. long. Such a long rotating beam has a high deflection, and the bearings are mounted so they assume the proper angle. The weight of the specimen itself provides added stress in the middle of the span of about 6,000 lbs./in.² above that imposed by the loading weights. Over a 24" span the decrease in stress from the maximum is so small as to involve less error than do the measurements of diameter. Breaks more than 12" away from the center were disregarded, but 90% of the breaks were in that region, the added stress in the middle of the span leading to fracture there rather than at the collets. Special spring collets used for holding the wire are shown. A photograph of the apparatus is shown in Fig. 8, page 74, of the February, 1931, Vol. 2, No. 2, issue of *Metals & Alloys.* The mathematics of the stress calculations are given, as are the precautions taken to avoid resonant vibrations by proper choice of speed. Tests were carried out at 2000 r.p.m. on galvanized heat-treated wire, at 1900 r.p.m. on the same with zinc coating removed, and at 1700 r.p.m. for low carbon wire. Tests were carried to 10 million cycles unbroken. The data follow:

Material	Tensile Strength lbs./in²	Fatigue Limit lbs./in²	Fatigue Ratio
0.77% C wire quenched, tempered and galvanized	215000-230000	50000	.22
Same with coating stripped in HCl-$SbCl_3$	226000-230000	60000	.26
0.13% C steel wire not galvanized. The galvanized coating has a deleterious effect	69000	46000	.66

Tests on short specimens of the galvanized high carbon wire with ends swaged so as to prevent breaks at the ends which were threaded into special holders, also gave 50,000 fatigue limit. Machined short specimens reduced to 0.15" diameter at the breaking section of the high carbon steel gave an endurance limit over 100,000, i.e., the endurance ratio was .44. Similar specimens of the low carbon wire gave 56000 and endurance ratio of .81. This high endurance ratio is not explained. If "69,000 tensile" is a misprint for 96,000, the high endurance ratios on the low carbon steel would become more normal. The method of testing should be applicable to tubes and pipes. Includes discussion in which Peterson illustrates a method of preparing a cantilever fatigue specimen by boring it out with a parabolic-nosed tool so that the outside of the specimen need not be machined down, yet it will not break at the grip. H. F. Moore comments on the fact that since a slight change in range of partially reversed stress does not materially affect the endurance limit, small vibrations of an endurance specimen do not necessarily affect the result. HWG (6f)

Resistance to Alternating Forces and its Determination by Means of Hardness Testing Machines. (La Résistance aux Efforts A Iternés et sa Détermination à l'aide des Machine d'essais de Durée). *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Sept. 1931, pages 465-473.

A description of 3 new testing machines for fatigue determination. 1. Rotational alternation fatigue machine, in which the usual load applied by weights is replaced by a graduated beam on which a uniform load slides to give the desired total load on the specimens. This device reduces the space required by the weights as used in the old type machines. 2. Alternating torsion machine. 3. Tension-compression along longitudinal section of the specimen by means of electromagnets and spring principles. GTM (6f)

The Fatigue of Metals. H. F. MOORE. *International Congress Testing Materials, Amsterdam,* 1927, Part 1, page 297.

Most engineering formulas for the strength of materials were developed by civil and not mechanical engineers and are accurate only for static stresses of large structural members. Experience with axles and Wohler's rotating beam tests showed that failures might take place under alternating stresses at lower loads than called for by the accepted engineering formulas. The concept of a perfect elastic limit as a stress below which Hooke's law holds and repeated loadings are harmless depended on the postulate that material is continuous and homogeneous. Metallography has shown that this postulate is not true, except statistically on a large scale. Basquin in 1910 showed that the fatigue tests then reported did not indicate a definite endurance limit for materials. Later, more extensive endurance testing resulted in re-establishing the existence of a limit of stress below which a metal will withstand an indefinite number of reversals without fracture. There is a fairly good correlation between the endurance limit and tensile strength; in ferrous metals the former is about half the latter. Fatigue failure, as studied with the microscope, seems to be the spreading of localized fracture, rather than merely a slip. Irregularities in stress distribution weaken metal in fatigue, but not as much as the mathematical theory of elasticity would predict. Slip under repeated stress may occur without the development of a fatigue crack. The exact cause of the origin of a fatigue crack is not known but it is not known to occur without slip. Clean metal, smooth surfaces and avoiding sudden changes in section will improve fatigue strength. Rosenhain, in discussion, stated that fatigue failure has been known to occur without slip; failure in fatigue occurs by the exhaustion of ductility as in tension, but at a lower stress because the slip is in both directions. (6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Influence of Acidity of the Electrolyte on the Structure and Hardness of Electrodeposited Nickel. D. J. MACNAUGHTAN & R. A. F. HAMMOND. *Transactions Faraday Society,* Vol. 27, Oct. 1931, pages 633-648.

Paper, accompanied by 3 tables and 7 diagrams, in which a description is given of an attempt to obtain further data concerning the influence of the conditions of deposition on the structure and hardness of electro-deposited Ni. The solutions used were typical of those used in commercial practice. Deposition was carried out at a constant temperature of 35 ± 0.5° C. and at a constant current density of 11 amps./ft.². The Brinell hardness of the deposits was determined and their microstructure examined. The results show that the acidity of the solution exerts a very marked influence upon the hardness and structure of the deposit, low acidity favoring the formation of hard deposits having a finely crystalline structure. It was found in each solution examined there was a critical pH above which a rapid rise in hardness with pH took place. It is thus possible by suitably adjusting the pH of such solutions as are described, to obtain hard or soft deposits. Confirmation is obtained of the previously published conclusion that for the production of hard deposits a nickel-sulphate solution buffered with ammonium salts is the most suitable. For the production of soft deposits solutions containing boric acid and sodium fluoride with boric acid, respectively, appear to be more suitable. OWE (7a)

Electroplating Aluminum on Production Basis Practicable with Process Control. W. S. MCARDLE (Aluminum Co. of America) *Automotive Industries,* Vol. 66, Jan. 16, 1932, pages 98-99, 110.

Technique developed by Harold K. Work built on improvement in surface preparation methods, including cleaning, activation, and roughening. Degree of success attained in an electroplated Al job depends on 2 factors: (1) metal surface must be properly cleaned prior to etching; (2) most important of all, etching must be deep enough to provide adequate anchorage for the plating. This etching is accomplished with special reagents, depending upon purity of Al. Three common etching solutions are: high metal dip, low metal dip, and acid dip. The acid dip is 1 (HF): 3 (HNO_3). DTR (7a)

Throwing Power of Plating Solutions with Particular Reference to Certain Zinc Plating Solutions. B. K. BRAUND. *Transactions Faraday Society,* Vol. 27, Oct. 1931, pages 661-674.

An article, accompanied by 3 diagrams and 5 tables, deals with work undertaken as part of a general investigation of the electrodeposition of metals upon Al and Al alloys. For determining throwing power, Braund used the method devised by Hering and Blum. 3 different plating solutions were used in these experiments. Conclusions regarding the points that should be observed in using the Hering and Blum apparatus are given. OWE (7a)

Chromium-Plating of Paper-Mill Rolls. R. E. CLEVELAND, *Paper Mill & Wood Pulp News,* Vol. 54, Jan. 24, 1931, pages 14-15.

A brief discussion of the advantages of Cr-plating paper-mill rolls to increase their life by its hardness and resistance to corrosion. WHB (7a)

The Electrochemical Behavior of Platinum in Hydrochloric Solution. (Ueber das elektrochemische Verhalten des Platins in salzsaurer Lösung.) G. GRUBE & H. REINHARDT. *Zeitschrift für Elektrochemie,* Vol. 37, June 1931, pages 307-320, *Siebert Festschrift,* 1931, pages 108-120.

Pt is dissolved anodically in concentrated, hot HCl. Electrodeposited Pt is more readily soluble than rolled Pt. When it is deposited at the cathode strong polarization takes place due probably to formation of a film, and generation of H. A strongly adhering Pt deposit can be obtained from a solution of 0.1 m.H_2PtCl_6 in 5N Hcl at 60° C. and a current density of 1 to 2 amp./dm.². Ha+HWG (7a)

Nickel Plating Practice Abroad. W. T. GRIFFITHS. *Electrical Times,* Vol. 81, Feb. 4, 1932, pages 147-149.

A review of the methods employed in the United States and in continental plants; especially in the factories of Automobil Renault, Paris; plant of Société de Radiateurs Chassez, Paris; Citroen; and Opelwerke, Germany. WR (7a)

The Electrolytic Dissolution and Deposition of Metals. (Ueber das elektrolytische Auflösen und Abscheiden von Metallen.) J. HOEKSTRA. *Recueil Travaux Chimiques des Pays-Bas,* Vol. 50, Mar. 15, 1931, pages 339-342.

Under ordinary conditions of electrolysis the voltage—current density curves for the deposition of metals usually have a logarithmic form but if the electrodes are continuously rubbed, the curve becomes a straight line. Photomicrographic examination of metal deposits during the progress of electrodeposition shows that the metal is deposited in layers of about 1000 atoms in thickness; the surfaces of the crystals become covered with "active lines," which vary in shape and number with the conditions of deposition, and which spread over the surface of the crystals with increasing time of deposition. Fe, Ni, and Co deposits do not follow these rules, but are built up of relatively thick layers of nodular shape. Ha (7a)

Investigation of "Chromprotekt." (Untersuchungen über das Chromprotekt.) B. RASSOW & L. WOLF. *Chemiker-Zeitung,* Vol. 55, Jan. 28, 1931, pages 73-76.

Chromprotekt is a commercial product supposed to prevent poisonous Cr fumes from escaping from the Cr plating solution when the solution is covered with it. The claims made for it by the manufacturers were investigated. It is a refined petroleum with the addition of some ester to reduce its odor. The plated parts lose their brightness when removed from the tank, necessitating polishing. Chromprotekt produces some objectionable fumes itself and the gases escaping from the tank are not free from Cr. The idea of using a petroleum product was not an original idea of the manufacturers. CEM (7a)

Electroplating and Polishing Equipment and Supplies. LOUIS M. HAGUE. *Metal Industry,* N. Y., Vol. 29, Nov. 1931, page 486.

Recent growth of the industry of the polishing and plating of metals calls for men of special qualifications. Such qualifications are discussed. PRK (7a)

Bath and Pickling Containers in Electroplating. (Bad-und Beizgefässe in der Galvanotechnik.) H. KURREIN. *Metallwarenindustrie und Galvanotechnik*, Vol. 29, Mar. 1931, pages 213-215.

Tanks made of an artificial phenol-formaldehyde resin to which asbestos is added, are recommended for acid Cu and Zn baths, Ni baths, phenol-sulphonic acid, Sn and Pb baths, tartaric and acetic acid baths and neutral liquids. This material will stand rapid changes of temperature and has a low heat and electric conductivity, and light weight. Ha (7a)

Electrometallurgy (7b)

Effect of Cobalt on Technical Zinc Electrolysis. (Einfluss von Kobalt auf die technische Zinkelektrolyse.) P. RÖNTGEN & R. BUCHKREMER. *Metallwirtschaft*, Vol. 10, Dec. 25, 1931, pages 963-967.

Contains 7 references. The effect of Co additions on the yield of Zn under varying working conditions was determined in a series of tests. In colloid free electrolytes Co reduces the yield considerably. 10 mg./L. Co at 20 amp./dm.^{2}, room temperature, and 100 g. H_2SO_4/L. is harmless. But with about 100 mg./L. Co and 100 or 200 g. H_2SO_4/L. the yield is very low unless very high current densities are used. The addition of a proper amount of colloid such as gelatin overcomes the effect of Co entirely, especially when the temperature is raised. For instance the yield in a solution containing 100 g. H_2SO_4, 0.5 g. gelatin and 100 mg. Co/L. at 60° C. was 93%, while in the same solution without Co and gelatin at 20° it was only 83%. With 300 g. H_2SO_4/L. less than 10 mg. Co is permissible, with 200 g./L. H_2SO_4 up to 100 mg. Co, and with 100 g./L. H_2SO_4 up to 500 mg. Co, through addition of gelatin and increased temperature. With higher current than 20 amp./dm.^{2} more Co is permissible. Photographs of the cathodes are included showing the effect of Co and gelatin additions on the smoothness and corrosion of the deposit. CEM (7b)

The Production of Zinc by Electrolysis. I. HARRY HEY. *Chemical Engineering & Mining Review*, Vol. 24, Feb. 5, 1932, page 164-169.

Present practice in Zn production is of cyclic nature and involves the following steps: (1) roasting the raw sulphide under conditions that cause conversion to ZnO and a controlled amount of $ZnSO_4$, (2) leaching and dissolving the ZnO from the calcines using spent electrolyte produced in (4): (3) purification or removal of impurities interfering with the electrodeposition of Zn and contaminating the deposit, (4) electrolysis of the purified solution, whereby it is depleted of some of its Zn with the regeneration of equivalent H_2SO_4 for reuse in the leaching step; (5) melting the cathode Zn and casting the molten metal; and (6) treatment of residues or precipitates which contain substances possessing value. Most of the raw material is obtained from mixed Pb-Zn ores, which are treated by the flotation process for the production of Pb and Zn concentrates. Co is usually removed by "As purification" in which it is precipitated with As and Cu by the addition of Zn dust. Sodium arsenite and $CuSO_4$ are added to the solution, which is heated and then treated with Zn dust: or by the use of Na-β naphtholate Chlorides are removed by adding of Ag_2SO_4. AgCl is then reconverted to sulphate by treatment with Zn dust and heating with H_2SO_4. Rigid control during purification and accurate analysis enable the concentration of impurities in the feed solution to be maintained within very narrow limits. WHB (7b)

Electrolyses in Fused Phosphates. I. Electrolytic Preparation of α- and β-Tungsten. (Elektrolysen in Phosphatschmelze. I. Die elektrolytische gewinnung von α- und β-Wolfram.) HELLMUTH HARTMANN, FRITZ EBERT & OTTO BRETSCHNEIDER. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 198, 1931, No. 1-2, pages 116-140.

Experiments were made in an effort to deposit W electrolytically from fused alkaline phosphate solution. Pure metaphosphate fusions were found unsuitable for the deposition of pure W, but from a mixture of pyrophosphate, metaphosphate and WO_3 with addition of NaCl, pure W was obtained between 650° and 700° C. Similar results were obtained from a solution of WO_3 in pure $Na_4P_2O_7$. Röntgenographic study of W so obtained indicated a new substance in addition to the already known cubic, body-centered crystal W, this new substance being identified structurally as a β-modification of W. β-W crystallizes cubically according to a characteristic type with 8 building bricks; the length of the cubic edge $a = 5.04$ A. U. Complete agreement is obtained between observed and calculated intensity of the individual lattice planes if the 8 W atoms are arranged in the centers of gravity 000, ½ ½ ½, 0 ¼ ½, 0 ¾ ½, ½ 0 ¼, ½ 0 ¾, ¼ ½ 0, ¾ ½ 0. The new form of β-W is confirmed by quantitative chemical analysis and testing weight constancy through thermal treatment in a high vacuum at 900° C. At about 650° C there is a slow irreversible transformation into the α-form. Above the transformation point W separates only in the α-form, below it in the β-form. During electrolysis in the region of the transformation point the β-form is slowly converted into the α-form. Density determinations show that this is dependent upon grain size. Ha (7b)

Electrolysis in Molten Electrolytes. (Schmelzfluss-Elektrolyse.) J. BILLITER. Vol. 3 of Technische Elektrochemie. Second, enlarged and revised edition. Wilhelm Knapp, Halle (Saale), 1932. Paper, 6¼x9 inches, 196 pages. Price 14 RM.

This volume treats of the production by electrolysis from fused salts of the metals of the alkali and alkaline earth groups and of magnesium, aluminum, beryllium, and cerium, etc.

It is indexed. It probably gives a fairly accurate picture of Continental practice, though even there much of the information given is taken from patent literature, while American practice seems to be judged very largely from patent literature. Some of the same illustrations of calcining kilns for alumina and reduction pots for aluminum are shown as are shown in Edwards, Frary and Jeffries "The Aluminum Industry," but we find no reference to that book. Relatively few references to technical literature are given.

The usual topics are dealt with. The volume is a convenient compilation, but most of its contents are available in English in rather more up to date and authoritative form. H. W. Gillett (7b)-B-

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Calorizing, and Its Applications. WALTER SMITH. *Metallurgia*, Vol. 5, Apr. 1932, pages 207-208.

On calorizing, a layer of $FeAl_3$ is formed on the surface. In use at high temperatures Fe diffuses into this layer and the δ solution results. This material likewise protects the underlying Fe or steel from oxidation. Calorized mild steel or cast-Fe articles can be used at temperatures between 600 and 950 °C. For higher temperatures special alloys must be used. Calorizing increases the life of Ni-Cr alloys and Ni-Cr steels used at temperatures above 1000 °C. JLG (8)

Wire Galvanizing Processes. Part V. GEOFFREY K. RYLANDS. *Wire & Wire Products*, Vol. 7, Feb. 1932, pages 49-51, 56-57.

In this concluding installment, the author maintains the equality of the hot-galvanizing process to the electro-galvanizing method and tries to show that even in the latter method impurities in the zinc coating can occur. Ha (8)

Waterproof Iron Coating for Concrete Walls. *Iron and Steel of Canada*, Vol. 15, Feb. 1932, page 17.

An article, accompanied by 1 photograph, in which a method of surfacing the interior walls of buildings by means of a spray gun with Ferrotite, which is a mixture of powdered iron, accelerator, and water, plus a small amount of cement is described. OWE (8)

Evaporation of Platinum in Vacuum From a Tungsten Filament. JOHN STRONG. *Physical Review*, Vol. 39, Mar. 1932, pages 1012-1013.

Pt may be evaporated in vacuum at temperatures below the fusion or evaporation temperatures of W. This makes possible the substitution of the evaporation technique for sputtering. Previous attempts to evaporate Pt were unsuccessful because it was not possible to heat it sufficiently when a small piece was simply laid in a W coiled filament. The evaporation is easily effected when Pt is electro-deposited onto the W filament. The citric acid Pt plating solution used near 100° C. is satisfactory for this electrodeposition. Best evaporation deposits are obtained when the work is shielded from the hot W filament until after the fusion temperature of Pt has been attained. For the conservation of Pt the filament may be inclosed in a box made from W foil. A window in this box allows the evaporation to be restricted as desired. The Pt deposited on the walls of the box may be dissolved in hot aqua regia or if a Cu box is used the Pt may be peeled off in the form of thin foil. Mirrors, interferometer plates, fibers, etc., may be coated with Pt by this technique with less trouble and better results than by sputtering. WAT (8)

The Causes and the Prevention of Explosions in Silvering Glass. JACQUES WOLF. *Glass Industry*, Vol. 13, Jan. 1932, pages 5-6.

The explosions that occur most frequently in mirror silvering, are those caused by the formation of silver amide and fulminating Ag. The measures to be taken, in order to avoid explosions, are as follows. The ammoniacal Ag and alkaline solutions must be prepared separately and diluted. Solutions must never be mixed in a concentrated condition, but only after each has been diluted according to the prescribed proportions of the process. The silvering liquid must be protected against the sunlight and kept in a cool place. The Ag solution must never be prepared more than one or 2 days before use, the alkaline solution may stand longer with safety. Mix the 2 diluted solutions only immediately before using. The alkaline solution must always be poured into the Ag solution, never conversely. For the preparation of the reduction liquid, the acid must always be poured into the Ag solution, never conversely. Silver nitrate must never be poured into the ammonia, the process must be reversed. WAT (8)

Sherardizing. FRED L. WOLF (Ohio Brass Co.). *Metals & Alloys*, Vol. 2, Dec. 1931, pages 341-342.

The author reports briefly on the experience of his company with sherardizing malleable Fe over the period 1911 to 1923 with results that show this method of protection to be inferior to hot dip galvanizing. Difficulties were encountered in maintaining a uniform product from the sherardizing process. WLC (8)

The Cathodic Projection (Sputtering) of Elements and Various Applications. (Sur la Projection Cathodique des Elements et quelques Applications.) F. JOLIOT. *Annales der Physique*, Vol. 15, Apr. 1931, pages 418-436.

The theory of cathodic projection is summarised with references to the various original investigators. Apparatus for cathodic projection are described. In order to obtain oxide free cathodic surfaces of easily oxidized metals, a secondary cathode is first coated with the desired metal by thermal projection in a very high vacuum. Methods of preparing very thin films (up to 50mμ) without support are described, and the use of cellulose acetate as a preliminary support is described in detail. Thick films may be obtained by sputtering on a cellulose acetate base and then electroplating. Several uses of sputtered metal films are described, including the formation of sensitized photographic plates and the construction of a high-sensitivity, low-inertia bolometer. Methods of measuring the thickness of metallic films are discussed and it is pointed out that the use of densities as given in standard tables leads to erroneous results. 18 references. Ha (8)

Steel-Cored Aluminum. EDGAR T. PAINTON. *Electrician*, Vol. 107, Nov. 27, 1931, pages 733-735.

Steel-cored Al is being used extensively in transmission lines throughout the world. Where steel-cored Al has but one layer of Al over the core the galvanized core may be dipped in a bituminous solution before stranding up the cable. The latest important development is the use of sector-shaped Al wires instead of wound wires, resulting in a reduced diameter with the accompanying economy. WHB (8)

Hard Facing in the Steel Industry. W. A. MOORE. *Welding*, Vol. 3, Feb. 1932, pages 88-91.

A good wear-resisting metal should possess the quality of red hardness to a marked degree. The author tells how money can be saved by applying hard-facing materials on parts subjected to excessive abrasive wear. Many applications of hard-facing of steel mill machinery parts are explained and illustrated. TEJ (8)

Molybdenum Contacts for Rapid Regulators. (Molybdänkontakte für Schnellregler.) W. von Berlepsch-Valendas. *Elektrotechnische Zeitschrift,* Vol. 53, Jan. 21, 1932, page 64.

Mo proved to be greatly superior to Ag for rapidly operating contacts of a hammering motion, particularly if one contact is flat and of a larger surface than the other contact which has a concave surface so that the actual contact is annular. Such contact operated over 5,500 hours before regrinding was necessary, against 100 hours of Ag contact. Ha (9)

The Different Bronzes Employed by the Railroad Companies. (Les Différents Bronzes utilisés par les Compagnies de Chemins de Fer.) R. Loiseau. *Cuivre et Laiton,* Vol. 5, Jan. 30, 1932, pages 33-37.

This is a tabulation of the various bearing metals used by the French Railroad Companies; their composition and application are described. See also *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 67. Ha (9)

Alloys of Copper Used in Marine Service. (Les Alliages de Cuivre Utilisés dans la Marine). M. Ballay. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Nov. 1931, pages 560-574.

In this article is brought to light the progress realized on the development of Cu alloys and their uses during the last years, as has been recorded in the metallurgical literature. GTM (9)

Light Metal in the Automobile Fire-Ladder. (Leichtmetall im Automobil-Drehleiterbau.) Castner. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 402-404.

General description and illustrations. Ha (9)

The First All Light-Metal Fire-Ladder. (Die erste ganz-Leichtmetall-Leiter.) Castner. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 404-406.

Description of ladders up to 66 ft. made of Lautal. Ha (9)

Magnesium and Its Alloys. (Le Magnésium et ses Alliages). R. Cazaud. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Oct. 1931, pages 504-513.

This is an extension of a previous article, "Le Magnesium et Ses Alliages," *Aciers Spéciaux, Métaux et Alliages,* Mar. 1929, pages 83 and 131. The advantages in using Mg alloys in aeronautical construction are well emphasized in this paper. GTM (9)

Points on Making Duralumin Tanks and Riveted Joints. A. Eyles. *Machinery,* Vol. 38, Oct. 1931, page 135.

Duralumin sheets used in fabrication of tanks are generally heat treated to increase tensile strength. They are heated, quenched and aged. Heating may be done in furnace or salt bath. Electricity, gas or oil may be used but coal, coke and charcoal should not be used as they form explosive mixtures. Tanks should be riveted as welded joints often suffer from corrosion. Rivets should be of the same material as that welded. RHP (9)

Casting of Bronzes which have to Withstand Pressure. (Les Moulages de Bronze devant resister a la Pression.) M. Gossieaux. *Cuivre et Laiton,* Vol. 5, Jan. 30, 1932, pages 39-40.

A brief description and discussion of the bearing metals used in the American Navy, and the practice of molding and casting. Ha (9)

Driving Rods of Duralumin for Locomotives. (Lokomotiv-Pleuelstangen aus Duralumin.) *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, page 401.

It is reported that the results of the past 10 months are satisfactory. Ha (9)

Nickel and Its Alloys Used in Decorating. (Le Nickel et ses Alliages dans la Décoration.) By the Committee of Studies of "Centre D'Information du Nickel." *Aciers Spéciaux, Métaux et alliages,* Vol. 6, Aug. 1931, pages 383-403; *Revue du Nickel,* April 1931, page 35.

General remarks on the uses of Ni as a decorating medium. Topics discussed are Ni and Cr plating, use of Cu—Ni alloys, pure Ni, Monel metal, and the uses of 18:8 non-corrosive alloy. GTM(9)

The Longest Fire-Ladder of Light Metal in the World. (Die längste Feuerwehrleiter der Welt aus Leichtmetal.) Castner. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 406-410.

The ascendable height of the ladder is 135 ft., which can be increased to 155 ft. The number of rungs to be climbed is 165. The parts are joined together by riveting. Details of construction and illustrations are given. Ha (9)

Nickel Cast Iron for Pistons and Cylinders. Thomas H. Wickenden (International Nickel Co.). *Machinery,* Vol. 38, Oct. 1931, page 140.

Abstract of a paper before the Society of Automotive Engineers. Paper given in full in the S. A. E. Journal, Vol. 29, Oct. 1931, pages 328-331. See "Nickel Alloys in Automotive Manufacture," *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 67. RHP (9)

Despite Low Tonnage, Nickel Alloys and Plating Processes Gained Momentum in 1931. Robert C. Stanley (International Nickel Co.). *Automotive Industries,* Vol. 66, Feb. 20, 1932, pages 254-255.

Research effort achieved brilliant results which will be employed when business swings back to normal level. Ni plating, Ni alloys, various uses of Ni and Monel metal are described. The "T" Ni welding wire has been found successful in both gas and electric welding. DTR (9)

Progress in the Construction of Tank Cars. (Fortschritte im Tankwagenbau.) H. Staffehl. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 399-401.

A few recent constructions are described, especially tank cars with measuring chambers by which the customer can see for himself that he gets the proper amount of liquid; a great number of claims is said to have been eliminated in this way. The saving in weight of the empty car resulted in a greater carrying capacity. Ha (9)

Building First Long-Span Bridge in Maine. D. B. Steinman & C. H. Gronquist. *Engineering News-Record,* Vol. 108, Mar. 17, 1932, pages 386-389.

The Waldo-Hancock suspension bridge features twisted-wire strand cables, Vierendeel-truss-type towers, and continuous girder approaches. The bridge is fully described and is of the latest of the twisted-wire strand cable structures so far built. CBJ (9)

Aerial Lead-Covered Cable. Paul Suransky (Pacific Gas & Electric Co.). *Electric Light & Power,* Vol. 9, Nov. 1931, pages 21-23.

Pacific Gas and Electric Company has installed 8.2 miles of aerial cable having commercially pure Pb sheaths, 7.5 miles of which have been installed 5 years or more. High strength galvanized guy wire of various sizes was used as the messenger. Metal cable rings, spaced 15-18 ins. apart, were used to suspend the cable from the messenger. Experience with the cable has been unsatisfactory. In a run of 3300 ft., 32 breaks were found in the Pb sheath. These occurred about 1.5-2 ft. from the attachment to the cross-arm, where the rings had become displaced and allowed the cable to sag. The breaks indicated fatigue of the Pb sheath. It is believed, however, that satisfactory performance can be obtained if the cable has 1% Sb in the Pb sheath, and if careful consideration is given to its installation in order to obtain the required sag of the messenger. MS (9)

The Use of Aluminum Alloys in the Construction of Railroad Cars and Street Cars. (Die Verwendung der Aluminium Legierungen im Eisenbahn und Strassenbahnwagenbau.) Felix Thomas. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 386-399.

The paper reviews and compares the present utilization of Al alloys for the construction of railroad cars and street cars, their application in different countries with tables of steel and Al cars, and the materials used. The saving in operating cost is usually considerable, comparative figures from France, England, U. S. A. and Germany are tabulated. Vehicles and details of construction are illustrated. Ha (9)

Construction of Winding and Ventilation Shafts of Steel in Westphalian Coal Mines. (Ausbau von Hauptförder-und Wetterstrecken in Stahl auf westfälischen Steinkoklengruben.) Vollmar. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, Mar. 14, 1931, pages 317-320.

Rigid and elastic constructions of different sections are described and the details of joining the parts and segments illustrated. 14 references. Ha (9)

Iron or Wood Ties? (Eisen- oder Holzschwelle?) Rudolf Vogel. *Stahl und Eisen,* Vol. 52, Feb. 18, 1932, pages 166-169.

Discussion of pros and cons for iron and wood railroad ties. Graph is given showing life of iron ties and pine-wood ties saturated with $ZnCl_2$, $ZnCl_2$ + tar oil, tar oil by Rüping's method. Rüping's method of soaking pine-wood ties in tar oil gives longest life next to iron ties. DTR (9)

Light-Weight in Car Construction. A. H. Woolen. *Railway Age,* Vol. 91, Aug. 1931, pages 283-286.

Tabulations show the saving in weight of steam and electric cars by the use of Al. HA (9)

The Use of Non Ferrous Metals in the Shipping Industry. Francis A. Westbrook. *Metal Industry,* N. Y., Vol. 30, Jan. 1932, pages 1-3.

The uses and quantities of non-ferrous metals utilized by the shipbuilding industry are mentioned. PRK (9)

The Use of Light Metals in the Swiss Postal Administration. (Die Verwendung von Leichtmetallen in der Schweizerischen Postverwaltung.) von Salis. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 365-375.

A number of trucks for transportation of mail, automatic doors, trailers, conveyors, etc., made of Al and light alloys are described and construction details illustrated. Ha (9)

Interurban Railroad Car of Light Metal. (Leichtmetal-Stadtbahnwagen.) G. Wagner. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 3, Dec. 1931, pages 376-385.

The detailed construction of motor-equipped cars and trailers of the German State Railroad is described; the weight of the former is 18 tons, the latter 12.5 tons; a saving against steel cars of 9% and 10% respectively was obtained. Ha (9)

German Steel Frame Constructions and Comparison with Concrete and Reinforced Concrete Structural Work with particular Reference to Hoist Frames. (Der deutsche Stahlfachbau und sein Verhältnis zum Beton- und Eisenbetonbau, insbesonders beim Fördergerüstbau.) L. Schmitz. *Montanistische Rundschau, Stahlbautechnik,* Vol. 23, June 16, 1931, pages 49-54; July 16, 1931, pages 57-59.

The author gives experiences gained on the utilization of steel in structural work on the continent. Attention is focussed on some characteristic hoist frames which are compared with reinforced concrete constructions of the same kind. The writer emphasizes the merits of steel constructions which he claims to be superior. EF (9)

The Use of Non Ferrous Metals by the Steam Railroads. Frances A. Westbrook. *Metal Industry,* N. Y., Vol. 30, Feb. 1932, pages 49-50.

Some of the most important uses of Cu, Zn, Pb, Ni, Al, Sn, and the extent to which they are used are mentioned. PRK (9)

Precautions in Using Stainless Steels, Monel Metal and Chromium Plate for Bearings. George A. Luers. *Machinery,* Vol. 38, Dec. 1931, page 254.

These metals are good for corrosion resistance but sometimes give trouble when used together in sliding or rotating parts. The accompanying table shows what action may be expected.

Two metals in frictional contact	Results
Stainless steel and monel metal	Seizes
Stainless steel and bronze	Fair
Stainless steel and babbitt	Best
Monel metal and stainless steel	Seizes
Monel metal and bronze	Seizes
Monel metal and babbitt	Best
Chromium plate and chromium plate	Seizes
Chromium plate and steel	Seizes
Chromium plate and cadmium plate	Fair for limited use
Chromium plate and bronze	Good
Chromium plate and babbitt	Best

RHP (9)

Mechanical Specifications. *Automotive Industries,* Vol. 66, Feb. 27, 1932, pages 304-364.

Specifications for American, British and Continental motor vehicles, tractors, Diesel engines, airplane engines, etc., are given in complete detail. Summary of all specifications valuable to manufacturer, distributor and consumer. DTR (9)

JOINING OF METALS & ALLOYS (11)

Soldering (11b)

How to Obtain Good Results With Silver Solder. F. J. Giroux. *Welding*, Vol. 3, Mar. 1932, pages 161-162.

Silver solders vary in tensile strength from 40,000 to 60,000 lbs./in.^{2}. Their melting points range from 1325° F. to 1600° F. according to the amount of Ag contained, and their electrical conductivity depends upon the Zn content. The author gives information on soldering procedure for various alloys, discussing proper application of heat and the compositions of fluxes used. Borax and boric acid are good fluxes for Ag solder. TEJ (11b)

Welding & Cutting (11c)

Factors that Affect the Welding Qualities of Steel. Wilmer E. Stine. *Paper before the American Iron & Steel Institute*, Oct. 23, 1931. 14 pages.

See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 71. Ha (11c)

Discussion of Paper on "Factors Affecting the Weldability of Steel" by Wilmer E. Stine. *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 30-35.

Discussion of paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in Journal of the American Welding Society, Vol. 10, Sept. 1931, pages 22-26. See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 71. TEJ (11c)

A. C. Arc Welding. *World Power*, Vol. 27, Feb. 1932, pages 89-90.

A new type of alternating current welder has been developed in which an oscillator is used to stabilize the A. C. arc. The oscillator applies a high-frequency discharge at a comparatively high voltage to the welding terminals in parallel with the welding current. This keeps the path of the arc ionized. By means of the oscillator, as soon as the electrodes are brought within welding distance of the work, the arc starts itself. The welding transformer is constructed so the current can be adjusted in small steps. The oscillator is made up of a voltage transformer, spark gaps, condenser, and air-core choke coil. The A. C. arc has an advantage over the D. C. arc for work on thin materials because its penetration is somewhat less. Greater penetration and speed can be obtained by using a larger electrode and a higher current. In strength the welds made by the A. C. arc compare favorably with D. C. welding. WAT (11c)

Progress in Aluminum Welding. (Fortschritte im Aluminiumschweissen.) *Die Metallbörse*, Vol. 21, June 27, 1931, page 1205.

The present state of hammer and gas welding and electric welding applied to Al is summarized. The following analyses of low alloyed Al suitable for welding are included:

	%	%	%	%	
Cu	1.3	2.25	2.0	2.25	
Ni	1.3	1.3	1.3	1.3	
Mg	0.1	1.6	0.8	1.6	
Fe	1.0	1.4	1.4	1.4	balance: Al
Ti	0.18	0.1	0.1	0.1	
Si	2.2	1.25	0.7	0.5	

EF (11c)

Ninety-three Miles of Pipe Line Gas Welded. *Welding*, Vol. 3, Feb. 1932, pages 109-110.

Interesting methods used by contractor in Northern Colorado. TEJ (11c)

A Discussion of Piping Design. Herbert P. Smith. *Welding*, Vol. 3, Jan. 1932, pages 43-46; Mar. 1932, pages 179-182.

The text of this article is the author's views and opinion of the paper entitled "Frictional Resistance and Flexibility of Seamless-Tube Fittings Used in Pipe Welding," presented by Sabin Crocker and Arthur McCutchan at the Annual Meeting of the American Society of Mechanical Engineers, at New York, Dec. 1-5, 1930. The author states that pressure drop or frictional loss is not increased by the flow of fluids through short radius pipe bends. Part II. Design methods for welded square type expansion loops and their cost of installation. TEJ (11c)

Present Practice in Rail Bonding. Pliney P. Pipes (Ohio Brass Co.). *Paper presented to the 32nd Annual Convention of the International Acetylene Association*, Chicago, Nov. 1931, 4 pages; *Journal American Welding Society*, Vol. 10, Nov. 1931, pages 44-45.

Rail bonds for carrying propulsion currents on electrified roads and for maintaining tract circuits for control of railway automatic signaling, can be applied quickly and economically with the oxy-acetylene torch and a Cu alloy rod. These bonds have low permanent contact resistance and a shearing strength of about 30,000 lbs./in.^{2} This practice is approved by the American Railway Engineering Association. Ha + TEJ (11c)

Tract Joint Construction Methods. *Transit Journal*, Vol. 76, Mar. 1932, pages 132-134.

Thermit welding is used for repair work under traffic and Butt welding for new construction by the Third Avenue Railway System, New York City. Methods and equipment are discussed. CBJ (11c)

Tests of Welds. *Engineering Experiment Station Bulletin* No. 11, *University of Illinois*, Vol. 28, Nov. 11, 1930, 37 pages.

The paper deals with hand welding of the relatively thin steel plates used in the fabrication of storage tanks for oil and water systems; electric welds and static tests only were investigated. Sixty-six different specimens of weld-rods were used. The V-type seems to be the best for making butt-joints in ½" plates. The weakest rod specimen showed 46,000 lbs./in.^{2}, the average for all was 54,400 lbs. The excess material was machined away so that the sections of body of specimen and of weld was the same; no heat-treatment was applied after the weld. The strengths of the specimens welded by the same workman, but with various rods, were fairly consistent; the lowest average for any one rod being 50,531 lbs./in.^{2}, the highest 60,360 lbs. The strength with uncoated rods was 57,500 lbs./in.^{2} with beads laid longitudinally and 43,300 lbs. transversely. Ha (11c)

Welded Piping Installed in a Private Home. *Welding*, Vol. 3, Feb. 1932, pages 107-108.

Because it is leak proof, such an installation is ideally adapted to a vapor system of heating. The installation included approximately 1,580 linear inches of oxy-acetylene welding. Approximate welding costs are given which include heating, bending, straightening and fabricating. TEJ (11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Melting of Aluminum in Crucibles. (Das Schmelzen von Aluminium in Tiegelöfen.) *Die Metallbörse*, Vol. 21, May 16, 1931, pages 915-916.

Discusses the properties of Al which must be borne in mind when selecting crucibles for melting Al and the present state of Al melting technique is considered. EF (12a)

High Frequency Induction Furnace Study—Preparation of Silicon-Aluminum Steels for Generator and Transformer Sheets in High Frequency Induction Furnace. (Zur kenntnis des Hochfrequenz-Induktionsofens V. Ueber die Herstellung von Silizium-Aluminium—Stahlen für Dynamo-und Transformatorenbleche in Hochfrequenz-Induktionsofen.) FRANZ WEVER & GUSTAV HINDRICHS. *Mitteilungen Kaiser-Wilhelm-Institut für Eisenforschung*, Vol. 13, Report No. 194, 1931, pages 273-289.

Includes bibliography of 83 references, 5 tables, 16 diagrams. Exhaustive critical review is given of (1) historical development of various materials used to decrease power losses in this type furnace; (2) effect of heat treatment and grain size on magnetization losses; (3) effect of impurities and alloying elements; (4) summary of all results. It was found with low-alloyed Si steels that remarkable improvement resulted from Al additions. The V_{10} numbers lie below the limiting values for average alloyed sheets, i.e., with a class B steel, containing 0.95% Si, a value of only 1.66 W/kg was attained by addition of 0.99% Al. With high-alloyed transformer steels improvements through Al were in the limits of several hundredths W/kg. Exact influence of Al on power loss number is most apparent with small additions, while an increase of Al above a certain amount practically produces no further improvement. Structure tests of Si-Al steels show plainly that they are subject to same rules as those of Si steels. Best value for power loss number can be obtained only if method of fusion and manufacture are so carried out that an even, uniform, coarse crystalline structure exists in the final product. Al produces lowering of power loss through its deoxidation property of Si steels. Above results obtained on small laboratory scale were all confirmed by means of an 8-ton melt in a basic-lined electric arc furnace. DTR (12a)

Steel Control in America. (Om amerikansk stalkontroll.) TRYGGVE HOLM. *Jernkontorets Annaler*, Vol. 115, Dec. 1931, pages 626-642.

Review of Herty's work. HCD (12a)

Melting of Scrap Brass in the Reverberatory Furnace. (Das Schmelzen von Altmessing im Flammofen.) E. T. RICHARDS. *Die Giesserei*, Vol. 19, Jan. 8, 1932, pages 5-9.

The different types of furnaces and their fuels, their influence on the oxidation, deoxidation agents, melting and pouring methods are reviewed and discussed. Chips should not be melted in reverberatory furnaces but first briquetted. A table of the heat of combustion of the technical metals for combining with 1 gram-atom oxygen is given. Ha (12a)

Some Effects of Temperature and Iron Oxide in the Manufacture of Basic Open-hearth Steel. W. J. REAGAN (Edgewater Steel Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 469, Feb. 1932, 12 pages.

Gives data obtained from commercial furnaces producing 0.60 to 0.80% C steel. From an extended series of tests it was found that: (1) The amount of FeO in the steel is proportional to that in the slag. (2) The FeO in the metal can be controlled by controlling the melting and working conditions. Fast melting or slow working tend to produce a low FeO content. (3) The % Mn in the steel is inversely proportional to the % FeO in the slag. (4) Rejections increase as the age of the furnace increases, which is due to lower furnace temperatures as the age increases. 2 references. JLG (12a)

The Economy of Using Baled Scrap in Open-Hearth Furnace Operation. J. PANZL & T. DAHMEN. *Rolling Mill Journal*, Vol. 5, Apr. 1931, pages 281-284, 289-290.

An abstract of a translation from *Stahl und Eisen*. (See *Metals & Alloys*, Vol. 2, Sept. 1931, page 182.) The charging time and attendant heat losses in charging with the cheaper grades of scrap iron may be considerably reduced by the installation of scrap baling presses. The author describes the construction, charging, operation, and control and power equipment of a rugged, hydraulically-operated baling press, which produces bales of scrap weighing 1100 lbs. at a capacity of 16,500 lbs./hr. A more powerful press is also described in detail which produces high-density "scrap ingots" weighing 4,400 to 5,500 lbs./bale at a capacity of 17,600 lbs./hr. These ingots are welded internally so completely that they may be forged or rolled directly without being subjected to the melting process. JN (12a)

Mercury Purification. BURROWS MOORE. (Thermal Syndicate Limited) *Industrial Chemist*, Vol. 8, Feb. 1932, pages 63-64.

Hg of high purity was required and absence of the chief metallic impurities usually found, namely, Cu, Pb, Fe and Bi. Distillation in vacuo was found to leave a certain amount of these impurities. A method devised consists of specially constructed apparatus (of fused silica or chemical resistant glass) in three parts, one for washing with reagents, one for drying, and one for filtering respectively. Design of apparatus is given. Washing solutions employed were KOH and HNO_3. Data is given of the metallic impurities present in, crude filtered Hg, product after three distillations in vacuo, and crude filtered Hg after the treatment recommended respectively to illustrate the effectiveness of the latter method. RAW (12a)

Extraction of Antimony in the Copper Refining Process. (Antimonentfernung beim Raffinierprozess von Kupfer.) RAYDT. *Die Metallbörse*, Vol. 21, May 23, 1931, page 966.

The author denies the harmful effect of Sb in Cu up to 0.1%. It is difficult to meet the English specifications of 0.05%. Two attempts to remove Sb according to Kohlmeyer proved to be a failure. First method: Conversion of Sb_2O_3 into Sb_2S_3 by pyrite addition to the melt and volatilization by large steam pressures. Second method: segregation of Sb_2O_3 by cooling down of the melt. The author is nevertheless inclined to believe that a reduction of the Sb content is possible by additions of S. EF (12a)

The Bessemer Process. JAS. CUNNINGHAM. *Metallurgia*, Vol. 5, Feb. 1932, pages 139-141.

Mainly a review of the reports recently issued by the Steelworks Committee of the Association of German Ironmasters. JLG (12a)

Furnace Manipulation Governs Inclusions in Acid Open-Hearth Steel. C. H. HERTY, JR. & J. E. JACOBS (U. S. Bureau of Mines.) *Foundry*, Vol. 59, Nov. 15, 1931, pages 40-42, 44.

Abstract of a paper read before the Western Metal Congress in San Francisco. See "Clean Steels from the Acid Open-Hearth," *Metals & Alloys*, Vol. 2, Oct. 1931, page 224. VSP (12a)

Theory and Practice of the Harris Process. (Theory und Praxis des Harris Verfahrens.) W. JENSEN. *Die Metallbörse*, Vol. 21, Sept. 19, 1931, pages 1737-1738; Sept. 26, 1931, pages 1769-1770; Oct. 3, 1931, pages 1801-1802; Oct. 17, 1931, pages 1856-1857; Oct. 24, 1931, pages 1897-1898.

States 17 chemical reactions underlying the Harris Process, a method of softening Pb by the use of soda salts. The actual consumption of $NaNO_3$ is compared with the amount of salt theoretically determined with reference to 1 kg of As, Sn and Sb respectively. The balance of the paper outlines the commercial accomplishment of the Harris process and shows the successive removal of As, Sn and Sb. The most economical composition of the mixtures employed, mainly consisting of NaOH and NaCl, and the working up of the exhausted salts for the recovery of marketable salts of As, Sb, and Sn is covered. The efficiency and the difficulties encountered in the plant operation are critically discussed. The construction of the Harris apparatus and the capacity of installations according to Harris are given. EF (12a)

Equilibria Between Metals and Slags in the Melt. I. The Equilibrium FeO + Mn ⇄ Fe + MnO at 1550 to 1560° C. (Ueber Gleichgewichte zwischen Metallen und Schlacken im Schmelzflusse. I. Das Gleichgewicht FeO + Mn ⇄ Fe + MnO bei 1550-1560°.) W. KRINGS & H. SCHACKMANN. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 202, Dec. 15, 1931, pages 99-112.

The mass law constant $K = \frac{[Mn]\cdot(FeO)}{[FeO]\cdot(MnO)}$ was determined to 0.0032 ± 0.0005, in percent; the ideal mass-law holds good in this equilibrium. The method of the investigation is described. Ha (12a)

The Influence of Iron Oxide on Sintering and a few Practically Important Properties of Dolomite for Steelworks Use. (Die Einfluss des Eisenoxyds auf Sintering und einige praktisch wichtige Eigenschaften bei Stahlwerks dolomiten.) OTTO KRAUSE & HERMANN GUHR. *Feuerfest*, Vol. 7, May 1931, pages 129-136.

Experiments to determine the influence of Fe oxide on the sintering and on the softening under pressure of dolomitic refractory materials are described, and their causes are discussed on the basis of X-ray investigations. WHB (12a)

Chemical Kinetics of the Open-Hearth Steel Process. ERIC R. JETTE. *Rolling Mill Journal*, Vol. 5, Apr. 1931, page 268.

Abstract of a paper presented at the New York meeting of the American Institute of Mining and Metallurgical Engineers. See *Metals & Alloys*, Vol. 2, May 1931, page 105. JN (12a)

Effect of Manganese in Production of Steel. (Untersuchungen über das Verhalten des Mangans bei der Stahlerzeugung.) FRIEDRICH KÖRBER. (Düsseldorf). *Stahl und Eisen*, Vol. 52, Feb. 11, 1932, pages 133-144.

Includes discussion, 16 diagrams and 13 references. Report 221 of Steel Mill Committee of Verein deutscher Eisenhüttenleute. On basis of laboratory tests equilibrium relations were established between manganese-Fe and slags, consisting of almost all FeO and MnO, in temperature range 1520 to 1950° C. The constants of the Mn-equilibrium between molten metal and slag were calculated by use of simple mass action laws. Values obtained, however, do not fall regularly on a smooth curve, and it was also observed that equilibrium concentrations at experimental temperature are materially altered during the cooling down period. Values for heats of reaction for Mn decompositions, as calculated from curve, agree rather well with those obtained by calorimetric measurement. Oxygen analyses show an almost linear rise of O_2 with temperature. Solubility of MnO in the molten bath becomes almost zero due to solubility of FeO. On the basis of these results, deoxidation-equilibrium diagram of Mn is shown first for liquid deoxidation products. Modifications of this diagram for ideally diluted slags were discussed, as their composition is more or less similar to that of technically pure slags. From a solidification-phase diagram of the system FeO-MnO, and assuming a simple arithmetical increase of the lowering of fusion point of Fe by O_2 and Mn, limits were defined in the concentration planes (Mn)-(O_2) for the separation of liquid and crystalline deoxidation products from metal bath. By means of this complete deoxidation-phase diagram for Mn, for which is also given a diagrammatic sketch of space diagram, the course of separation of slags or deoxidation products for fusion of increasing Mn and O_2 contents were given. The separations which were found by microscopic tests agree absolutely with those of the derived phase diagram. For a series of Thomas fusions, the entire fusion behavior of the metal and slag samples were examined. The changes in content of the foreign substances present in the Fe during smelting operation were discussed. The sharp decrease, of the constants of Mn-equilibrium, is to be regarded as the indication for the sudden change of acid slag characteristics into the basic, which is of particular importance for the metallurgical reactions occurring. Relations between effect of temperature of added ferromanganese and period of time for fusion to take place, and completion of deoxidation, were established. An especially sharp decrease of the total O_2 content was found during solidification of the ingot in mold; these reactions are well illustrated by means of the complete deoxidation-phase diagram. Discussion brings out equilibrium constants for different SiO_2 content of slags. Also effect of calcium metasilicate, calcium orthosilicate, and free lime. DTR (12a)

The Desulphurization of the Steel Bath. (Zur Entschwefelung des Stahlbades.) G. Tammann & H. O. V. Samson-Himmelstjerna. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 202, Dec. 24, 1931, pages 329-336.

A few reactions were investigated which can serve for the desulphurization of the steel bath; the reactions with BaO and soda were stronger than with lime. Pb vapor developing in the steel bath had also a desulphurizing effect. The heats of formation and reaction are tabulated and the times of desulphurization with various chemicals given in diagrams. 17 references. Ha (12a)

Making of Aluminum Alloys Rich in Copper and Nickel. (Herstellung von kupfer- und nickelreichen Aluminiumlegierungen.) Thews. *Die Metallbörse,* Vol. 21, Nov. 23, 1931, page 2059.

Shows how to economically overcome the difficulties due to the high melting point of Ni and Cu and tendency toward segregation. The writer advises pouring both metals together in the liquid state with the observance of some precautions, discussed in the article. EF (12a)

Phosphorus as Deoxidizer for Copper Alloys. (Phosphor als Desoxydationsmittel für Kupferlegierungen.) Thews. *Die Metallbörse,* Vol. 21, Oct. 3, 1931, pages 1802-1803.

The preparation of the P bearing Cu alloys as deoxidizer is anticipated and the handling of "P-bronze" for deoxidizing purposes with special reference to Cu and its alloys is discussed. The effect of P added in excess is considered. EF (12a)

The Melting Shop of the Appleby Iron Company, Limited. Arthur Robinson. *Engineering,* Vol. 131, May 8, 1931, pages 616-618; May 15, 1931, pages 650-651; May 22, 1931, pages 686-688.

Includes discussion. Condensed from paper read before the Iron and Steel Institute, London, May 7, 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 18. LFM (12a)

Remelting of Nickel for the Manufacture of Sound Pure Nickel Plates for Anodes. (Umschmelzen von Nickel zur Herstellung von dichten Reinnickel-Platten für Anoden.) Leo Schmal. *Zeitschrift für die gesamte Giesserei-praxis, Das Metall,* Vol. 52, June 7, 1931, pages 61-64.

Choice of deoxidizing agents; crucible employed in melting; deoxidizing process; production of pure Ni castings; manufacture of Ni anodes. WHB (12a)

The Metallic Charge in Basic Open-Hearth Operations—Some Factors Affecting Operating Economies. C. D. King. *Yearbook American Iron & Steel Institute,* 1931, pages 387-451.

Includes discussion. The paper is devoted to a treatment of the general principles underlying the conversion of metallic charges into basic open-hearth ingots and covers some important factors influencing operating economies. These include the effect of charges on yields, scrap production, and the possible conversion of some losses into scrap recovery. The influence of types of scrap used and changes in ratios of pig iron and scrap is also discussed and illustrated in tables. Hot metal plants, cold metal plants, and duplex plants are dealt with. The general conclusions are set forth as follows: In any investigation of the effect of the metallic charge in basic open-hearth operations as affecting operating economies, it is necessary to determine to what extent ingot yields can be increased for equal conditions. Assuming that the slag volumes and analyses of slags are as required for the type of steels produced, increased yields can only be accomplished by limiting the pit scrap, steel skull, iron scrap, and iron skull production to a point consistent with the economical operation of the plant concerned. Such an improvement may lead to material savings, the magnitude of which will vary with the efficiency of the practice at the plant in question. Excessive scrap production has a material influence on the final ingot cost and at times may warrant measures which may increase the cost above net metal, but result in a lower cost of net metallic mixture and, therefore, result in reducing the total ingot cost. Further savings are possible at those plants which are in position to convert some part of the losses into scrap credit, namely, the use of open-hearth slag at blast-furnaces and the utilization of checker chamber dust in flue dust sintering operations. The various discussions dealing with changes in proportions of the components of the metallic charge show that within limits the open-hearth furnace is sufficiently flexible to consume varying amounts of pig iron and steel scrap and that under certain conditions these changes may be made advantageously. The success of such changes will depend upon the differentials existing between pig iron and scrap, the effect on production capacity, cost above net metal, and, particularly, on other operating departments. Tables of practical data illustrate the considerations. HA (12a)

Change of Composition of Steel in a Basic Lined Ladle. Melts Made in a Basic Lined Furnace. (Ueber die Aenderung der Zusammensetzung des auf basischem Futter erschmolzenen Stahles in der Giesspfanne.) Peter Bardenheuer & Alfred Ranfft. *Mitteilungen Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 13, Report 195, 1931, pages 291-305.

Extensive number of melts in the basic Siemens-Martin furnace and in the Thomas furnace showed changes in composition of the steel, taking place in the casting ladle during casting period. By skimming the furnace slag from the steel and covering with a neutral protective layer, changes in steel composition were avoided. Reactions of the ladle slag with the ladle lining and the steel are so much more active, the greater the amount and the higher the temperature of slag. Cause for this condition is evidenced by decrease in slag basicity through absorption of SiO_2 and Al_2O_3 by lining. Reduction of oxides in slag with non-Si steel is produced by Mn, and with Si steel, mainly by Si. The higher the Si content, with same conditions, the greater will be residual P as well as reduction of MnO in slag. With large amounts of slag or longer casting period, far greater change in steel composition, particularly enrichment of oxides, may be obtained. The O_2 increase is chiefly due to increase of deoxidation products. In Si steel the O_2 is mainly combined with Si. Discussion of causes of reactions between steel and slag in ladle is excellently brought out. Includes 16 diagrams and 23 tables of data. DTR (12a)

Forging (12d)

Defects in Large Forgings. III, IV. G. A. Smart. *Heat Treating & Forging,* Vol. 17, Nov. 1931, pages 1038-1041, 1048; Dec. 1931, pages 1107-1110, 1117.

It is of great importance that the forging be worked into shape at a rate such that it is finished with its temperature as near the critical range as possible, so that the proper grain size is obtained. In drawing down an ingot between flat dies, it is important that the die faces be parallel with each other and that the sharp corners on the edges of the dies be removed. If the corners are left sharp, laps or cold shuts will appear on the surface of the forging. To prevent shear cracks in reducing a large round section to a small round section on a pair of flat dies, the stock should be reduced to a square section, the area of which should be approximately that of the round section desired. This is then reduced to an octagon and then to the round section. V dies are also used in reducing to small round sections with good results. Clinks are due to improper cooling of a partially forged ingot. If cooled to below 1000° F., ingot should be properly annealed. Describes proper operation to be followed in the forging of a rotor shaft, a ring and a hollow forging. Part IV. Discusses various processes of heat treating large forgings, such as annealing, normalizing and spheroidizing. MS(12d)

Forging High-Chrome Steels. J. B. Nealey (American Gas Association). *American Machinist,* Vol. 75, Nov. 26, 1931, pages 812-813.

It is very important to preheat in a controlled furnace, separate but adjacent to the forging furnace. Preheating requires at least twice as long as for carbon steels. Preheating temperatures must be kept below the carbon precipitation point for Ni steels and just under the grain growth range for Cr steels. Rapidity of heating in the second furnace is essential. The treatment used in some cases, used as an example of proper treatment of alloys of certain composition is described. RHP (12d)

Forging of Rustless Steel. J. B. Nealey (American Gas Association). *Iron Age,* Vol. 128, Dec. 17, 1931, pages 1544-1547, 1584.

Ordinary steels forge easily at red heats of 1400° F. and up; forging pressures can easily be estimated. When Cr or Cr and Ni are added, in amounts required in stainless alloys, pressures necessary for forging jump 200-300% or more. The addition of greater amounts of S to the 0.12% C-13% Cr steel has done much to advance the use of rustless steel. Favorable machining of KA2 type of steel can be produced only through very accurate heat treatment and close control of forging temperatures. Considerable experimental work on these steels has been done by the General Motors Corp. A definite line of demarcation between preheat and forging heat is controlled by keeping preheat temperature below C precipitation for Ni steels and just under the grain growth range for Cr steels. An analysis of the steel used in making rustless steel golf club heads is given. Welding flanges weighing up to 300-400 lbs. are made of Cr-Ni steels of the 18 and 8 series. VSP (12d)

Shearing & Punching (12e)

A Circular Knife-End Shears for Single Sheets and Packs. (Kreismesser-Saumscheren für Einzel- und Paketbleche.) Louis Frielinghaus. *Stahl und Eisen*, Vol. 52, Jan. 28, 1932, pages 84-86.

Circular shears for single sheets are in common use, and the application of circular knife-end shears for cutting sheet metal and packs of sheets is described. Performance and necessary men given for this type of work. Illustrations of 2 shears in the plant of Schoemann & Co., Düsseldorf are shown, for shearing, No. 1 from 50 to 80, and No. 2, 80 to 100 tons per hr. It is claimed that shears No. 1 do the same work as 3 to 4 ordinary end shears, while shears No. 2 are equivalent to 5 to 6 ordinary shears. Knife renewal after production of 35 to 40 thousand tons of packs. Diagrammatic sketch of circular knife-end shears given. DTR (12e)

Extruding (12f)

The Extrusion Press in the Working of Non-Ferrous Metals. L. G. Mitchell (Brass Co. of Australia Pty. Ltd.) & H. Stewardson (Brass Co. of Australia Pty. Ltd.). *Chemical Engineering & Mining Review*, Vol. 23, Sept. 5, 1931, pages 460-464.

A description of a 1000-ton hydraulically-operated extrusion press manufactured by Davy Bros. at Sheffield. The furnace used for heating the billets is an open-chamber, underfired oil furnace with a hearth sloping from the charging door to the discharging door. The operation is continuous. The billet is extruded from the press and converted into a complete and intricate section. Extrusion has been applied to Sn, Zn, Cu and Al, also certain Cu-Zn, Cu-Al, and light Al alloys. O_2, Sn, As, P, Sb and Bi diminish the extrudability of the brasses, while Fe, Cd, Mg and Si in small quantities are desirable. Defects in extruded rod are classed as: (1) casting, (2) the die, (3) extrusion, and (4) reeling and straightening. Each class is briefly discussed. The flow of metal is down the axis of the billet—toward the center and front. WHB (12f)

Machining (12g)

Use and Abuse of Hacksaw Blades and Band Saws. L. B. Thompson. *Iron Age*, Vol. 128, Nov. 12, 1931, page 1237.

The most common form of abuse is failure to select the proper type of blade for material to be cut. Steel or cast iron require a high tempered saw. The correct tension in adjusting blades in the machine is of importance. To get the full use of the blade, a shim should be placed in the vise. VSP (12g)

Fine-Drilling. (Feinbohren.) *Automobiltechnische Zeitschrift*, Vol. 35, Feb. 10, 1932, pages 74-76.

Methods and machines for obtaining absolutely round, straight and cylindrical holes of smoothest surface are described and some micrographs of surfaces given. Ha (12g)

Tungsten Carbide Tools. *Engineer*, Vol. 152, Dec. 4, 1931, pages 603-604.

Well-illustrated article describing tests made by Alfred Hubert, Ltd., manufacturers of machines for using these tools. Tools used in the tests are built up with a Widia tip fixed in a recess cut in a mild steel shank. For tests on cast Fe speeds up to 200 ft./min. were used, 2 tools being in operation at the same time. With 4 tools in operation, 273.9 $in.^3$ of material was removed per min. Widia tools will stand any amount of compression but rubbing or tension quickly destroys the cutting edge. If these tools are run at too slow a speed wear will be rapid and results unsatisfactory. The machines used must have the necessary power and stability to give an even drive without vibration. LFM (12g)

A Test for the New Carbide Cutting Tools. A. W. Swanson. (Illinois Tool Works.) *Machinery*, Vol. 38, Dec. 1931, pages 265-267.

Suggests a test be made on a lathe using 3/32 in. depth and a feed of 0.020 to 0.030 in. at moderate speed, the lathe to be stopped every two minutes to examine the face of the tool. Whether a roughened surface resembling a crater appears is the test of its value for the particular operation. RHP (12g)

Machinability and Strength Properties of Steel and Cast Steel (Die Zerspanbarkeit und die Festigkeitseigenschaften bei Stahl und Stahlguss). A. Wallichs & H. Dabringhaus. *Maschinenbau*, Vol. 9, Apr. 17, 1930, pages 257-262.

Machineability test data plotted on semi-log paper show that doubling of feed reduces permissible cutting speed twice as much as doubling of chip thickness. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 43. (12g)

Use of Tungsten Carbide and Other Hard Cutting-Tool Materials Gaining. Coleman Seller (William Sellers & Co.) *Iron Age*, Vol. 128, Dec. 17, 1931, pages 1560-1563.

An abstract of a report of the sub-committee on metal cutting materials presented at the annual meeting of the American Society of Mechanical Engineers. The data presented was obtained from a canvass to determine the present status of the use of W and Ta carbides and other new cutting materials. The report stresses the need for scientific data regarding their applications. A number of tables are included. VSP (12g)

Machining of Steel is Conditioned by Quality of Metal. H. H. Bleakney (Department of Mines, Canada). *Iron Age*, Vol. 128, Dec. 24, 1931, pages 1608-1609, 1662.

The difficulty of machining is experienced in direct proportion to the number, size and hardness of the inclusions—other things being equal. Such inclusions as alumina and hard silicates, if present in excessive amounts, dull tools and cause poor performance, while manganese sulphide greatly promotes machineability. The effect of structural condition of steel upon machineability far outweighs the influence of inclusions. The best machineability is encountered when both hardness and ductility of steel are at a minimum. An annealed product, with a uniform lamellar pearlite, means smooth and rapid operations on the machine with excellent tool life. VSP (12g)

Drawing & Stamping (12h)

Effect of Wire Drawing Solution on the Power Required in Drawing of Ingot Steel Wire with Krupp-Widia Dies. (Ueber den Einfluss des Schmiermittels auf den Kraftbedarf beim Ziehen von Flussstahldraht mit Krupp-Widia-Ziehsteinen.) Anton Pomp & Albert Koch. *Mitteilungen Kaiser-Wilhelm Institut für Eisenforschung*, Vol. 13, Report No. 193, 1931, pages 261-271.

Two steel wires of following analysis & properties:

	Diam.	C %	Si %	Mn %	P %	S %	T.S. kg./mm.²
Ingot steel wire	A (5mm)	0.06	trace	0.43	0.029	0.035	36
" " "	B (4mm)	0.53	0.22	0.73	0.016	0.035	1004

were pickled in cold 2% H_2SO_4 for 1 to 2 hrs., rinsed with H_2O, and placed in milk of lime tank for 3 days, then dried in air before being drawn. The 2 wires were each drawn down to 4.0, 3.2, 2.6 and 2.1 mm. wires, average cold roll reduction of 35%, with varying angles of die 6, 9, 12, 15 and 18. Before and after each draw wires were gauged, T.S., power required for drawing, longitudinal stress, efficiency of stress, and appearance of wires were all noted. Powdered dry soap, rubbing oil, drawing oil, soda grease, and lime grease were the different wire drawing solutions or lubricants used. Rate of drawing wires was 1.5 m/s. Efficiency of stress was used as reference standard and is given by $\eta \text{ stress} = \frac{\text{A Theoretical}}{\text{A Total}}$ as developed by Pomp, Siebel, and Houdremont. Powdered soap was found to be a suitable lubricant, giving greatest number of draws, without causing grooves or roughening. Rape seed oil and drawing oil behaved alike, producing a rough wire on the 4th draw with wire A; however they were satisfactory for wire B. Greases or fats were poor lubricants. For wire A the most suitable die angle was 15°; with increasing hardness of material the die angle became smaller for good work. Effect of drawing speed on power required could not be accurately determined, no large differences in amount of power was required for different drawing speeds from 0.6 to 5.0 m/s. DTR (12h)

Graphic Methods for Determining Percentage Reduction of Area of Round Rods. L. W. Luff. *Wire & Wire Products*, Vol. 7, Feb. 1932, pages 44-45.

For the production of various tempers in the production of cold drawn rods and wires, charts are developed from which the required solution in a given case can be taken. Ha (12h)

The Production of Shaped and Fancy Tubes. *Metal Industry*, London, Vol. 39, Dec. 18, 1931, pages 581-582.

The method of manufacture of tubes and sections of thin gage by cold drawing is described. PRK (12h)

Reverse Drawing of Conical Shells. Paul Homer White. *Machinery*, Vol. 38, Nov. 1931, pages 174-175.

Description of a method in which the shell is turned inside out in the final operation which eliminates 2 draws and produces a smooth surface. RHP (12h)

Sliding Scale for Determining the Amount of Mixture and the Weight of Raw Material in Stamped Parts. (Schiebertafel für die Rohmengen- und Rohgewichtsbestimmung von Stanzteilen.) Hans Schmid. *Maschinenbau*, Vol. 10, Aug. 20, 1931, pages 529-531.

A new graphic method for determining the amount and weight of crude material in stamped parts is presented. The results in which all the waste material will be accounted for are obtained by a simple method in which it is only necessary to regulate the finished product. MAB (12h)

Technique of Steel Wire Drawing at High and Very High Resistance. (Technique du Tréfilage des Aciers à Haute et à très Haute Résistance.) G. de Lattre. *Aciers Spéciaux, Métaux et Alliages*, Vol. 6, Oct. 1931, pages 487-503; Dec. 1931, pages 623-643.

In this present study the author deals with the technique of wire drawing of steels containing carbon 0.4% to 0.9%. This analytical and critical study covers all the phases concerning wire drawing based on scientific treatment. In a general manner, the author introduces first the (a) preparation of wire, (b) the wire drawing, and (c) the finishing. As this paper is divided into chapters, the first chapter deals with the quality of metal. In the second chapter, the general theory of wire drawing is completely treated. Chap. 3 continues with the heat treatment of steel wire. Pickling is also completely discussed in Chap. 4 and in Chap. 5, the lubricants are considered. $CuSO_4$ and $SnCl_2$ and lead salt solutions are usually considered as successful lubricants by the virtue of chemical interchange between Fe and the metal of the salt, which metal deposits on wire. GTM (12h)

Forming Brake Drums for Lincoln Cars. J. B. Nealey (American Gas Association). *Iron Age*, Vol. 128, Nov. 12, 1931, pages 1228-1229, 1281.

Describes equipment and method used by the Lincoln Motor Car Co. in forming brake drums. Blanks for the drums are formed to final shape in a single operation. Press used weighs 125 tons and will exert a pressure of 1000-1500 tons. Furnace is a gas fired semi-automatic. VSP (12h)

Press Brake Dies and Auxiliary Equipment. F. H. Pfefferle (The Cincinnati Shaper Co.). *Metal Stampings*, Vol. 4, June 1931, pages 517-519.

Describes and illustrates the types of dies used in press brakes for forming deep boxes and discusses the design and operation of press brake accessories; such as spring pads, universal gages, universal and standard filler blocks, the ram clamp, and tongues for holding these dies in place. JN (12h)

Press Brake Forming Dies. Part II. F. H. Pfefferle (Cincinnati Shaper Co.). *Metal Stampings*, Vol. 4, May 1931, pages 423-425.

The author illustrates the types of dies used in press brakes and discusses the various operations involved in forming partially closed and completely closed beads, narrow gage channels, wide shallow channels and square posts in metals up to 14 gauge. The operations required in forming the single lock seam for joining 2 metal sheets and the Pittsburgh slip seam for joining 2 sheets at right angles are described in detail. JN (12h)

Cleaning (12k)

Degreasing Metals by the Vapor Process. E. V. D. WALLACE. *Monthly Review, American Electroplaters Society,* Vol. 18, Dec. 1931 pages 6-15; *Metal Industry,* N. Y., Vol. 30, Feb. 1932, pages 53-55.

Includes discussion. Paper presented at the Rochester Convention, 1931, of the American Electroplaters Society. The "Carrier Vapor Degreasing Process" is described as one for the removal of oil or grease from metal objects by immersing them in the vapor of a chlorinated solvent. Boiling trichlorethylene was kept in a Cu tank without cover, but heated by steam near the bottom and equipped with cooling coil near the top and above the vapor layer. Cold water was used in the coil to condense the vapor and prevent its loss through diffusion into air. Objects may be cleaned in 20 sec. in this vapor; an additional ½ to 2 min. may be required to allow solvent which has been condensed on the object to drip back into the bottom of the tank. Cost of operation with this process was estimated to be lower than all other metal cleaning processes. PRK + LCP (12k)

Degreasing of Metal Parts. (Entfettung von Metallteilen.) HANS HEBBERLING. *Oberflächentechnik,* Vol. 9, Feb. 1932, pages 33-35.

Methods of degreasing are discussed; where boiling is not possible, trichlorethylene has proved to be very effective. A few apparatus are described, tanks, in which the treatment can be carried out without injury to the workman, as inhaling trichlorethylene has an intoxicating and eventually toxic effect. Ha (12k)

New Washing Machine for Metals. *Brass World,* Vol. 28, Mar. 1932, page 60.

The Rex Products & Mfg. Co., Detroit, Mich., has marketed a vertical type machine for washing metal products of many kinds. "Penn-A-Chlor" is a special cleaning agent used in the machine and claimed to be a non-explosive non-inflammable, permanent, and acid-free both as liquid and as vapor. The work is placed on a conveyor and passes downward into the machine between powerful streams of boiling solvent, striking from all directions at a pressure of 35-lbs./in.^{2} Work and conveyor then pass upward, then through a rinse of distilled, hot solvent, and then upward and leaves the machine clean and dry. The process is most suitable for cleaning Zn or Pb coated metals, Al die castings or soft metals affected by ordinary alkali cleaners. WHB (12k)

The Bullard-Dunn Process of Cleaning. F. T. TAYLOR. *Monthly Review, American Electroplaters Society,* Vol. 18, Aug. 1931, pages 17-22.

Includes discussion. Paper before Philadelphia Branch of the American Electroplaters Society. Removal of scale or oxide film from iron and steel is effected by a cathodic treatment at 60-75 amp./ft.^{2}, 150° F. for a few minutes in a solution of H_2SO_4, chlorides and a small amount of Pb. During this treatment, the scale is said to be pushed off by the H generated between the metal body and the scale and, at the same time, a thin, adherent layer of Pb is deposited on the clean metal. This process does not etch the metal and has no danger of over-treatment. Pb anodes are used. See also *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 21. LCP (12k)

Automatic Metal Washing Machine. R. BELL. *Engineering Progress,* Vol. 13, Jan. 1932, pages 17-19.

Metals may be rapidly and economically cleaned with an automatic machine made by Hahn & Kolb, Stuttgart. Material to be cleaned is fed to a belt which travels through sprays of hot alkaline solutions. RHP (12k)

Cleaning Silver by Electricity. R. W. KENNEDY. *Electrical Review,* Vol. 110, Jan. 29, 1932, page 164.

To clean silverware rapidly and effectively at home, a china or enameled bowl is filled with a hot 5% washing-soda solution. The negative lead from a storage-battery is attached to the article to be cleaned, which is then totally immersed in the solution. A lead from the positive terminal is next immersed in the solution within an inch or two of the article under treatment. The Ag becomes brilliantly polished. The article is rinsed in warm H_2O and dried. No loss of Ag takes place by this method. MS (12k)

Polishing & Grinding (12l)

Curved Profiles Require Special Grinding Methods. *Abrasive Industry,* Vol. 13, Feb. 1932, page 20.

For accurate grinding of complex curved or angular surfaces it is necessary either that the wheel or the work be moved in such a path as to generate the required surface, or that the wheel be formed to cut its special shape into the work. The latter is known as form grinding. For form grinding, standard cylindrical or surface grinding machines may be used as contrasted to generating methods which require special machines. Few grinding machines have power enough to drive a formed grinding wheel greater than 10 in. in width. Grinding wheels of greater width are expensive and difficult to handle. The heat generated increases as the width of the cutting surface contact increases. These factors combine to limit the width of the surface cut with one wheel. In the generating method, a simple surface moved in the path required will generate a more complex surface. A straight grinding wheel can be caused to cut a concave or convex surface of revolution simply by swinging the axis of the grinding wheel about a point which is to be the radius of the surface to be cut if the periphery of the wheel is straight and has appreciable width. WAT (12l)

Modern Polishing Methods in Cleaning Ornamental Castings. *Abrasive Industry,* Vol. 13, Feb. 1932, pages 32-33.

Modern ornamental cast metal is superior to that formerly made. Some of the abrasive operations followed in cleaning and finishing Al and Monel metal castings are briefly described and illustrated. WAT (12l)

Correct Cutting Action in Surface Grinding. *Abrasive Industry,* Vol. 13, Jan. 1932, pages 15-16.

Plane surface grinding differs from cylindrical grinding in the positioning of the work and the wheel. The area of contact is greater and the rate of movement of the work in respect to the wheel is different. The work speed of traverse or ordinary surface grinding machines cannot be increased to change the wheel-cutting action. Wheel speed is the only adjusting factor. WAT (12l)

Wheel Speed Governs Production. *Abrasive Industry,* Vol. 13, Feb. 1932, pages 25-26.

The faster a wheel is operating the more cutting points per minute will be presented to the work. Since centrifugal force increases with the square of the velocity, a wheel at a peripheral travel of 6000 ft./min. is subjected to 4 times the strain of one running at a speed of 3000 ft./min. A wheel operated satisfactorily at 6000 ft./min. begins to act soft as it wears away. Correct operating speed on an electrically driven machine is maintained by adjustment of the work rest as the wheel wears. This automatically increases the speed. WAT (12l)

Grinding Magnesium Alloys. W. E. WARNER. *Machinery,* Vol. 38, Nov. 1931, page 170.

Brief discussion. Wheels similar to those used for aluminum may be used at a work speed of 80 ft./min. and a peripheral speed of 1000 ft./min. Silicon carbide wheels give the best results. Should be medium hard and of from 30 to 46 grain. Clogging of the wheel can be prevented by the use of a coolant, either kerosene or a 4% solution of sodium fluoride. Emery must not be used for grinding Mg alloys. RHP (12l)

The Last Achievements of Finishing Technique; Lapping in the Manufacture of Measuring Instruments. (Die letzten Errungenschaften der Fertigungstechnik; der Läppvorgang bei der Herstellung von Messwerkzeugen.) C. BUETTNER. *Werkstattstechnik,* Vol. 25, Mar. 1, 1931, pages 113-116.

The conditions of the lapping process are investigated and the influence which grinding and lubricating agents exert on tool and piece to be lapped explained. Ha (12l)

Notes on Polishing Stainless Steel. W. E. WARNER. *Machinery,* Vol. 38, Nov. 1931, page 181.

Very brief discussion. For polishing, use a fine-count buffing wheel at surface speed of 10,000 to 15,000 ft./min. As an abrasive, use emery powder with tallow or lard oil. For final polishing, use Tripoli powder and finish off with a dry cotton buffing wheel with no abrasive or lubricant. RHP (12l)

How Polishing Abrasives Have Been Improved. HENRY R. POWER (Carborundum Co.). *Machinery,* Vol. 38, Oct. 1931, pages 132-133.

Discussion of manufacture, testing, grading, cohesion and density. The use of aluminum oxide is mentioned. RHP (12l)

The Emery Wheel. F. A. W. LIVERMORE. *Brass World,* Vol. 28, Feb. 1932, page 27.

A high grade of skin glue is most satisfactory to use with the wheel. The glue should not be boiled and is applied with a brush. WHB (12l)

Cylindrical Grinding vs. Accuracy. FRED B. JACOBS. *Abrasive Industry,* Vol. 13, Jan. 1932, pages 12-13.

Accuracy is a relative term inasmuch as no part can be fabricated more accurately than the gages used to test it. To finish parts within close limits, substantial grinding machines must be employed to insure maximum production. WAT (12l)

Complete Descaling before Grinding. FRANK A. DEDRICK (Bullard Co.). *American Machinist,* Vol. 75, Nov. 26, 1931, pages 814-815.

Complete descaling is essential to rapid and accurate grinding. Several tables show the relative time of grinding necessary when the descaling has been done by the scratch brush method and when done by the Bullard-Dunn process. The latter process is more economical. Does not describe either method of descaling. RHP (12l)

Buffing Stainless Steels. L. R. EASTMAN. *Brass World,* Vol. 28, Feb. 1932, pages 33-34.

An attempt is made to cover briefly some fundamental principles, to note the history and outline modern methods of manufacture, classify the raw materials and products in a general way and illustrate basic factors involved in polishing, buffing and finishing of metals. WHB (12l)

Conservation of Grinding Wheels. E. H. FISH. *Abrasive Industry,* Vol. 13, Jan. 1932, page 14.

A grinding wheel may be sharpened by a dresser which loosens the bond so that the dull particles fall off. Abrasive wheel making is described. WAT (12l)

Coloring (12m)

Coloring of Metals. (Coloration des Metaux.) J. MICHEL. 3rd edition, Desforges, Girardot et Cie., France, 1931. Paper, 4¾ x 7¼ inches, 272 pages. Price 25 Fr.

A compilation of rule-of-thumb recipes for producing decorative coatings on metals. Protective coatings are not dealt with. The recipes are empirical and the reader has nothing to tell him whether the recipe is any good or not. Recipes for patinas on steel, copper, bronze, etc. are given. Niello is discussed. The book is apparently intended for the small jeweler. Worthless to the metallurgist. H. W. Gillett (12m) -B-

Sand Blasting (12n)

Cleaning of Castings with Steel Grit on the Rotating Table Blower. (Gussputzen mit Stahlkies am Drehtischgebläse.) H. GOMBART. *Die Giesserei,* Vol. 19, Jan. 8, 1932, pages 3-5.

The results are given of tests made to compare cleaning castings by steel blast instead of sand blast. After 6½ months operation it could be stated that steel grit is very well suited to blast cleaning and that it can be done with the existing apparatus for sand without modification. The surface of the cleaned pieces is smooth and dark gray. The steel blasting process is cleaner and more hygienic than sand blasting. Steel lasts much longer than sand keeping sharper edges much better; it was found that 1 kg. steel grit corresponds to about 30 kg. quartz sand. A comparison of costs gave a saving of 42% in favor of steel blasting, including material and wages, in spite of the considerably higher price of the steel grit (300 Mk. per ton against 15 Mk./ton in Germany.) Ha (12n)

Sandslinging Practice in the Foundry. A. J. S. Shewan & R. Atchison. *Foundry Trade Journal,* Vol. 46, Feb. 18, 1932, pages 111-112.

Paper read before the Lancashire Branch of the Institute of British Foundrymen, and dealing with the operation of a traction type sandslinger in a foundry where the work handled is very general, varying from small, mass-production castings of a few pounds to medium-size castings varying from 500 to 2,000 lbs. OWE (22)

Test Value of Soaking Cupola Charges. W. H. Spencer & M. M. Wolding (American Cast Iron Pipe Co.). *Foundry,* Vol. 59, Nov. 15, 1931, pages 26-27.

Abstract of a paper read at the Chicago meeting of the American Foundrymen's Association. Deals with a series of tests designed to find the effect of varying the soaking time. Results show that no especially beneficial results may be obtained from soaking the charges. It seemed as though more heat was lost through burning the bed during soaking time than was recovered in heating of the charge. Coke burned with natural draft over a long period did not give as much heat to the charge as coke which burned rapidly with the blast on the cupola. A number of tables are included. VSP (22)

The Value of Low Total Carbon Cast Irons. W. West. *Metallurgia.* Vol. 4, Oct. 1931, pages 187-192.

It is pointed out that, as the carbon content of gray iron decreases, the strength increases but the shrinkage also increases. The small shrinkage in high carbon iron is attributed to an expansion resulting from the formation of graphite. Experiments are described in which the effects of Si and C on the shrinkage and strength of iron were studied. The shrinkage was judged by the appearance of an intricate casting. The shrinkage was pronounced in irons containing less than 3.25 percent C. Variations in Si content had little effect on the shrinkage, but increased Si decreased the tensile and transverse strength. JLG (22)

The Electric Furnace in the Steel Foundry. (Le Four Électrique dans la Fonderie d'Acier.) H. Verdinne. *Revue Universelle des Mines,* Vol. 5, Mar. 1, 1931, Series 8, pages 135-138.

A general discussion of the use of the electric furnace in the steel foundry, its advantages with regard to economy and uniformity of product, and its growing use in the Belgian steel plants. Ha (22)

Handling of Graphite Crucibles in Melting Plants. (Behandlung der Graphittiegel im Schmelzbetriebe.) R. Thews. *Die Metallbörse,* Vol. 21, June 27, 1931, pages 1203-1224; July 4, 1931, page 1251.

Experiences gained on the use of graphite crucibles and precautions to prevent premature failure. The exact centering and proper mode of mounting of the crucible, the avoidance of draft, the use of soft-edged tools and the selection of a suitable coke low in S and moisture, the detrimental effect of gas and oil firing are taken up in the first part of the paper. The second part furnishes instructions in regard to proper melting and casting operations while using graphite crucibles mainly stressing the avoidance of sudden changes in temperature on heating and cooling and due to insertion of fresh material. The rough handling with tools is again prohibited. The paper concludes with the utilization of graphite crucibles in tilting furnaces. EF (22)

A Practical Method for Studying the Running Quality of a Metal Cast in Foundry Molds. C. M. Saeger, Jr. & A. I. Krynitsky. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 2, Dec. 1931, pages 513-540.

A test method for determining the "running qualities" of metal was developed. Results indicated that aluminum, brass and cast iron, cast in dry-sand molds ran further than the same metals cast in green-sand molds, and that with an increase in pouring temperature, the length of test specimens increased in a direct proportion. Aluminum is affected by the maximum heating temperature. CHL (22)

Electric Melting—Synthetic Cast Iron. Gilbert S. Schaller. *Western Machinery World,* Vol. 22, Dec. 1931, pages 573-575.

An article dealing with the application of the electric furnace to the modern foundry and the production of cast iron and steel by the acid and basic electric processes. WAT (22)

Cover of an Evaporating Pan made of Silumin. (Herstellung eines Abdampfdeckels aus Silumin.) G. Schüle. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Feb. 7, 1932, pages 64-65.

Description of how the cover (diameter:1500 mm) was molded and cast. GN (22)

Relation Between Shape of Grain and Strength of Sand. H. Ries & H. V. Lee. *Transactions & Bulletin American Foundrymen's Association,* Vol. 3, Feb. 1932, pages 857-860.

Tests on clean sand bonded with ball clay show that mixtures with rounded sand grains have lower permeability and higher compressive strength, in both the green and baked condition, than those with angular grains. CHL (22)

Pipes and Progress. William Phillips. *Foundry Trade Journal,* Vol. 46. Feb. 4, 1932, page 90.

A brief discussion of methods which have been adopted for the rapid production of rain-water and soil pipes. OWE (22)

Steel Foundry Molding Sands and Facings. A. S. Nichols. *Transactions & Bulletin American Foundrymen's Association,* Vol. 3, Feb. 1932, pages 827-842.

The characteristics, the costs and the ingredients in 60 facing and 60 molding sand mixtures representing materials used in a number of steel foundries were tabulated and critically analyzed. CHL (22)

Laboratory in the Foundry. (Le Laboratoire de Fonderie. Installation du Laboratoire et Travail en série Role du Chimiste). André Guédras. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, July 1931, pages 347-351.

Installation and work standardization of a laboratory in a foundry. GTM (22)

The Moore Hot-Blast Cupola. Jas. T. MacKenzie. *Iron & Steel Industry,* Vol. 5, Oct. 1931, pages 17-18.

Paper read at the Chicago meeting of the American Foundrymen's Association. See *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 108. CHL (22)

Electric Heat Solves a Foundry Problem. Wm. B. Ferguson. *Maintenance Engineering,* Vol. 90, Jan. 1932, pages 12-13.

Electric heating coils are used to heat patterns in a molding machine to prevent the molding sand from sticking to the patterns. WAT (22)

Place High Heads on Pressure Castings. David Evans. *Foundry,* Vol. 59, Nov. 1, 1931, page 53.

The size and location of gates and risers affect the soundness and strength of castings. Risers should be used so high and so large that all visible cavities are in the upper 2/3; this applies particularly in making valves and fitting. VSP (22)

Addition of Fluorspar to the Cupola. (Addition de spath fluor au cubilot.) D. Deuvorst. *Revue de Metallurgie,* Vol. 28, May 1931, pages 287-288.

See *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 108. JDG (22)

Oil-Sand Practice. B. Gale. *Foundry Trade Journal,* Vol. 46, Feb. 18, 1932, pages 118-120.

Paper read before the Lincolnshire Section of the Institute of British Foundrymen, in which the author discusses a few practical experiments on cores, using different grades of sand, which are referred to as fine, medium and coarse, and different kinds of binders. The article is accompanied by 4 tables. OWE (22)

Some Practical Notes on Oil-Sand Practice. H. W. Keeble. *Foundry Trade Journal,* Vol. 46, Feb. 25, 1932, pages 130-133.

Paper presented before the London Junior Section of the Institute of British Foundrymen, in which the author discusses the advantages to be gained by the use of oil-sand cores, raw materials employed in their production and examples of oil-sand core practice. The article is accompanied by 1 table and 4 photographs. OWE (22)

Electrolytic Process for Making Metal Patterns. Charles O. Herb. *Machinery,* Vol. 38, Dec. 1931, pages 241-243.

The Electro-Chemical Pattern & Mfg. Co., Detroit, Mich., produces metal patterns by depositing Cu electrolytically in plaster molds until a shell of substantial thickness has been obtained. These shells are used for molding surfaces of patterns and cores. Cu shells range from 1/32" to 1/4" in thickness and are backed by white metal. Allowance is made for a single shrink. RHP (22)

Foundry Sand Control. A. A. Grubb. *Transactions & Bulletin American Foundrymen's Association,* Vol. 2, Nov. 1931, pages 8-17; *Metal Industry,* New York, Vol. 30, Feb. 1932, pages 62-63; Mar. 1932, pages 100-101.

An exchange paper to the Dutch Foundry Association. The steps in the introduction and maintenance of sand control in a foundry are clearly described. The advantages arising from same are of extreme importance. PRK+CHL (22)

Electric Process Iron for Cylinder and Cylinder-head Castings. H. E. Bromer. *Transactions & Bulletin American Foundrymen's Association,* Vol. 2, Dec. 1931, pages 585-608.

When demands are heavy a duplex process of melting is used, melting in the cupola and refining and increasing the temperatures in the electric furnace. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. CHL (22)

An Efficient Molding Plant for Cast-Iron Ingot Molds for Steel Ingots. Robert Jones. *Foundry Trade Journal,* Vol. 46, Feb. 11, 1932, pages 105-106.

An article illustrating in detail the methods employed in the molding of cast-iron ingot molds having the big end up. The article is accompanied by 8 figures embodying details of the method of production. OWE (22)

Prevent Losses with Proper Gates and Risers. Pat Dwyer. *Foundry,* Vol. 59, Nov. 1, 1931, pages 47-49; Nov. 15, 1931, pages 37-39; Dec. 1, 1931, pages 47-49; Dec. 15, 1931, pages 26-28.

XX. Top gate has been blamed for conditions due either to sand in the mold or the manner of manipulating the sand. Coarse grade sand properly dried will resist cutting action of metal poured through the top of the mold. Cast iron pipes, constituting about 13% of all gray iron poured into castings in the United States are made by the use of top. Hydrants and other special pipe shapes are molded and cast horizontally and are gated according to a number of methods. A single sprue and a bull ladle suspended from a monorail take the place of multiple sprues. XXI. Incidents are quoted to show how vent passages correctly arranged cured a defect of long standing. The necessity of providing free egress for gas and steam from sand, especially sand surrounded by metal filling the mold is emphasized. Close examination of the defect and knowledge of the factors involved in the production of the casting are required to determine whether the defect is a blow hole, shrink hole or a combination of both. Risers should be kept open until solidification of the casting takes place. XXII. Large sink head, feeder or riser opening is placed on top of the mold to provide a place for reception of dirt coming up on top of iron as it rises in the mold. In many instances, a riser is of no benefit. The use of the reservoir type of head presents many desirable features, including thorough mixing of metal, opportunity for dross and occluded gases to escape instead of entering the sprue, and increasing the pressure exerted on the metal in the mold. Reversal of pattern in the mold will, in some instances, banish shrinkage defect. XXIII. In the manufacture of pulleys, trouble may be encountered in the cracking of spokes and rims, warped and distorted castings. These troubles may be caused by faulty design, faulty molding practice or faulty metal, and often by a combination of two or more of these. Unequal cooling speed is the direct cause of practically all pulley troubles in the foundry. The views of H. N. Tuttle, who covered the subject very thoroughly in the Sept. 1927 issue of Foundry, are included. VSP (22)

Sand Condition is Important in the Steel Foundry. John Howe. *Foundry,* Vol. 59, Sept. 1, 1931, pages 61-62.

Discussion of the amount of old sand that may be used on castings of a given weight and the causes and remedies for scabs on steel castings. Other topics taken up are the use of the proper facing and mixtures for making hard and soft cores. VSP (22)

Principles of Rational Gas Use in Steel Plants. I. E. Agte. *Domez* (Achievements of Metallurgy in U.S.S.R. and Abroad), No. 9, 1931, pages 76-88. (In Russian.)
The mechanism of the combustion of the different gases available in steel plants is described. Except for melting furnaces a gas should be selected to fit the required temperature conditions in preference to the use of recuperators. High pressure burners offer many advantages. (23)

Continuous Heating Furnace and Troubles with its Starting. B. E. Bielsky. *Domez* (Achievements of Metallurgy in U.S.S.R. and Abroad), No. 10, 1931, pages 61-77. (In Russian).
A description of billet-heating furnaces, the troubles encountered in their starting and operation and some of the remedies applied. (23)

Classification of Open Hearth Furnaces and Their Tonnage. L. M. Fortunato. *Domez* (Achievements of Metallurgy in U.S.S.R. and Abroad), No. 10, 1931, pages 1-23. (In Russian).
Better conception of the performance of an open-hearth furnace can be obtained when one considers its metallic yield per unit of bottom area. (23)

Electric Furnaces. *Metallurgist,* Sept. 1931, pages 130-131.
The first cost and the cost of operation of electric furnaces is still the first consideration in their use in spite of the superior quality of their product. VVK (23)

One-Ton High Frequency Induction Furnace. *Metal Industry,* London, Vol. 40, Jan. 1, 1932, page 14.
A general description is given of a 1 ton Metrovick (Metropolitan-Vickers Co.) furnace to be installed in the works of Messrs. Thos. Firth and John Brown Ltd. PRK (23)

Pulverized Fuel for Metallurgical Furnaces. *Crushing & Grinding,* Vol. 1, Jan.-Feb. 1932, page 120.
A general article listing metallurgical uses for pulverized fuel. AHE (23)

Large Electric Furnace Installations. Part I. Annealing. Part II. Heat-treatment of Steel. A. Glynne Lobley. *Metallurgia,* Vol. 5, Feb. 1932, pages 123-126; Mar. 1932, pages 151-154.
Descriptions are given of furnaces installed in the United States. JLG (23)

Pulverized Fuel and Its Various Fields of Application. G. E. K. Blythe. *Transactions Tokyo Sectional Meeting, World Power Conference,* 1929, Vol. 3, 1931, pages 735-746.
General. AHE (23)

Rotating Furnaces for Powdered Coal. (Les Fours Rotatifs au Charbon pulvérisé.) L. J. Gouttier. *Revue de Fonderie Moderne,* Vol. 26, Jan. 10, 1932, pages 1-8.
A detailed description is given of a rotating furnace for melting high-grade cast-Fe and malleable Fe. The furnace makes oscillations of about 45° permitting a very rapid and uniform heating of the charge; during the first period of heating a flow of high grade coal dust is used, later replaced by low grade coal. Operating results are given; about 7.5 kwhrs. were required per ton of material. Ha (23)

The Cleaning of Blast Furnace Gas. Guy Barrett. *Iron & Steel Industry & British Foundryman,* Vol. 5, Dec. 1931, pages 129-139.
A résumé of the knowledge of the wet washing, the electrostatic deposition, and the filtering methods for the cleaning of blast furnace gases is given. CHL (23)

A Comparison of the Use of Various Fuels in Copper-refining Furnaces. E. S. Bardwell (Anaconda Copper Mining Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 457, Feb. 1932, 18 pages.
The Cu-refining furnaces at Great Falls and the successful methods of using lump coal, pulverized coal, oil and natural gas as fuel are described in detail. The lump coal was the least efficient. Powdered coal increased the amount of slag, and the ash dropping on the bath tended to prevent a high rate of heat transfer between flame and bath. The B.t.u./lb. of Cu used with the various fuels were 1627, 1441, and 1670 for pulverized coal, oil and gas, respectively. Natural gas was the ideal fuel from the operating point of view. 2 references. JLG (23)

The Problem of Melting Furnaces for the Iron Foundry. (Le probleme du four de fusion dans la fonderie de fer.) T. Geilenkirchen. *Revue de Metallurgie,* Vol. 28, May 1931, pages 269-271.
See *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 108. JDG (23)

The Metallurgy of the High Frequency Induction Furnace. Part 4. (Zur Kenntnis des Hochfrequenz- Induktionsofens. 4. Weitere Beitrage zur Metallurgie des eisenlosen Induktionsofens). W. Hessenbruch. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, No. 13, Report 183, 1931, pages 169-181.
Studies on a high-frequency induction furnace of 300 kg. capacity, fed by a 100 kw. high-frequency generator of 500 periods are described, including the energy consumption and its distribution, the lining of the furnace, the metallurgical reactions, etc. The possibility of reactions between slag and metal are shown to compare favorably with those of an electric-arc furnace. The quality of steel produced in induction furnaces equals that of electric steel. GN (23)

The Fundamentals of Brass Foundry Practice. Part 28. R. R. Clarke. *Metal Industry,* N. Y., Vol. 30, Feb. 1932, pages 62-63.
A description is given of types of furnaces used for melting and alloying metals. PRK (23)

Pulverized Fuel for the Small Unit-Shell Type Boiler, Metallurgical and Chemical Processes. H. W. Hollands & E. C. Lowndes. *Transactions Tokyo Sectional Meeting, World Power Conference,* 1929, Vol. 3, 1931, pages 771-785.
The design of a combustion chamber to convert pulverized coal into producer gas is briefly described. It is small, temperatures are low (result—low upkeep), and ash is not carried into the tubes. Combustion of the producer gas is effected in the boiler tubes or on the working hearth (metallurgical furnaces), giving the highest temperature at point of use. Advantages of pulverized coal in puddling furnaces, steel ingot heating furnaces, forge furnaces, etc., are described. AHE (23)

Combination Burning of Blast Furnace Gas and Pulverized Fuel. Otto de Lorenzi (Combustion Engr. Corp.) *Combustion,* Vol. 3, Mar. 1932, pages 36-40.
Test data on a steam generating unit fired by blast furnace gas and pulverized coal in combination are given. Calculations are described for obtaining coal-gas weight ratios. Control systems and recent developments in furnace design and methods of firing are given for plants using these 2 fuels in combination. DTR (23)

Combination Forge Furnace and Steam Boiler Saves 22 Per Cent. of Forge Shop Fuel. J. B. Nealey. *Gas World,* Vol. 95, Dec. 19, 1931, *Industrial Gas Supplement,* pages 13-15.
The use of waste heat from the forge furnace in the steam boiler which supplies power to the hammer, is described. The way to obtain the closest heat balance possible between the furnace and the boiler and at the same time utilize all the waste heat from the furnace is shown together with the results of a 2 days test run, including the efficiency of the forge in heating steel, the percentage of total heat supplied utilized in heating steel, the overall efficiency, the average horse power developed by the boiler, and the cost of heating steel to forging temperature. MAB (23)

Nitriding Furnace and Equipment. W. J. Merten. *Fuels & Furnaces,* Vol. 9, Aug. 1931, pages 895-900; Sept. 1931, pages 1031-1034.
The Bell type of nitriding furnace, its equipment, the process, the design of nitriding containers, the container material and the ammonia tanks are described. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 189. Ha (23)

Combustion Equipment Revamping in Modern Production Plant Proves Profitable. Frank S. O'Neill (Link Belt Co.). *Combustion,* Vol. 3, Mar. 1932, pages 23-25.
Modern foundry practice at the Link Belt Co. plant, Indianapolis, Ind., where pulverized fuel is used for firing, melting furnaces, annealing ovens and steam boilers is described. The installation has effected considerable savings and has greatly improved operating results. Details of automatic control system are described. DTR (23)

Calculation of Wall Losses of Industrial Furnaces. (Die Berechnung der Wandverluste industrieller Öfen.) E. Maase. *Feuerfest-Ofenbau,* Vol. 7, July 1931, pages 97-102; Oct. 1931, page 147.
Diagrams are presented from which the losses due to thermal conductivity and gas permeability as well as the outside wall temperature can be taken directly. A graphical method of evaluating the temperature gradient of a wall consisting of 2 different materials is shown. The viewpoints essential for the calculation of the thermal conductivity of refractories are discussed. A table gives data on the thermal conductivity of various materials employed in furnace construction. EF (23)

The High-Frequency Furnace and its Use for the Manufacture of Steel Castings. T. R. Middleton. *Foundry Trade Journal,* Vol. 46, Jan. 28, 1932, pages 73-75.
The development of the high-frequency furnace, the progress which has been made during the last 4 years in the manufacture of larger furnaces, refractory materials suitable for lining such furnaces, the difficulties met in refining steel in these furnaces and the melting costs involved in this work are briefly discussed. OWE (23)

A Tilting Metal Melting Furnace Fired with Powdered Coal. (Tiegelloser kippbarer Metallschmelzofen mit Kohlenstaubfeuerung.) O. Beckmann. *Metallwirtschaft,* Vol. 11, Mar. 11, 1932, pages 154-155.
The powdered coal is carried by 25% of the air supply of a blower to the burner. The main part of the air is preheated to 250° to 300° C. and enters the burner at right angles to the stream of coal which enters vertically. This results in a long flame which follows a spiral path, with complete combustion of the coal and a higher flame temperature than can be obtained with oil. Combustion takes place in the melting chamber. A typical example is given showing the comparative amounts and cost of oil and powdered coal required to melt a charge. A saving of 55% is obtained by using powdered coal. CEM (23)

Industrial Furnaces for Gas. XII Accessory Equipment. L. E. Biemiller. *American Gas Journal,* Vol. 136, Jan. 1932, pages 32-34.
The principles and applications of temperature measurement and control are outlined. Pressure conditions in gas-fired furnaces are studied. The venting of furnaces in special cases is advocated. CBJ (23)

Electric Heat for the Metal Industries. J. C. Woodson. *Electrical World,* Vol. 98, Dec. 5, 1931, pages 1004-1007.
The present tendencies are: (1) for a rather rapid and extensive expansion of electric annealing (bright and semi-bright) to the wire, strip and sheet mills; (2) the use of artificial furnace atmospheres to secure special and better results; (3) a development of more of the large continuous electric furnaces for sheet annealing and normalizing and with artificial atmospheres; (4) a rather extensive development and application of the principle of inductive heating to numerous heat-treating processes now considered unsuitable. Several installations in various industries are illustrated. WHB (23)

The Design and Operation of Open-Hearth Furnaces. Part IV. C. W. Veach (The Bettendorf Co.). *Rolling Mill Journal,* Vol. 5, Apr. 1931, pages 255-258.
Maintenance costs in open-hearth operation may be reduced materially (1) by the installation of mechanical control equipment to insure complete combustion of fuel gases and maximum transfer of heat from the flame to the charge and (2) by changes in furnace design so that the lasting qualities of all vital parts may be more closely coördinated. Present day tendencies in the control of furnace gases, such as the use of flue dampers in place of reversing valves, the mechanical introduction of air to the checkers, the installation of coils for preheating the air used in atomizing fuel oils, and the wider use of recording instruments and control equipment in furnace operation have reduced the average fuel consumption per ton of steel from between 6 and 8 million B.t.u. to about 4½ million B.t.u. JN(23)

Some Metallurgical Characteristics of Induction Furnaces as Determined by the Absorption of Oxygen by Molten Nickel. F. R. Hensel & J. A. Scott (Westinghouse Research Labs. and Driver-Harris Co.). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 15 pages.

A rapid method for determining O in molten Ni was developed. It is a modification of the one developed by Herty for the determination of O in molten steel in which Al is added to the metal and the Al_2O_3 determined. Melts were made in a small induction furnace with NiO on top of the charge. The solubility of O in Ni increased with the temperature. The probable Ni-O diagram is given. Comparative tests on the rate of O absorption as affected by turbulence were made in a 60-cycle and a 5,000-cycle furnace (without the NiO cover). The O content increased with the turbulence, for the rate of absorption in the 60-cycle furnace was 3 times as great as in the 5000-cycle furnace. In the 60-cycle furnace O absorption was near saturation. Oxidation could be prevented by melting under an O-free atmosphere by methods described. 5 references. JLG (25)

The Solubility of Gases in Metals. V. H. Gottschalk & R. S. Dean. (U. S. Bureau of Mines). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 16 pages.

From theoretical considerations and from a survey of published work it is concluded that the simple solubility of gases in metals is extremely small, or for practical purposes negligible. Attention is called to the variable values of solubility obtained by various investigators using methods of great precision. It is suggested that the absorption of gases in metals may be explained by electronic phenomena. Before applying mass-law analyses to metal-gas systems it is necessary to know that the assumptions necessary for their application are justified. In applying these analyses to FeO-C equilibria in steel making processes it is usually assumed that the CO concentration is constant, which is by no means justifiable. 63 references. JLG(25)

Studying the Gases of Simple Steels. Henry D. Hibbard. *Iron Age*, Vol. 219, Feb. 25, 1932, pages 493-494.

Deals chiefly with steels made by the open-hearth process, and is limited to consideration of gases originating in or accompanying the making of steel. The story of the gases of a simple steel demands full knowledge, including source, composition quantity, means for control and effect of the following: (1) those in charge materials; (2) those evolved from metal in furnace during successive stages from melting to tapping; (3) those evolved from molten metal in the mold; (4) those in pipe cavity and in each kind of gas hole in ingot; (5) those retained in solidified steel; (6) those evolved from solid steel when heated to degrees between room temperature and fusion; (7) those evolved from steel when again melted; and (8) those liberated when metal is dissolved by various solvents. Steel scrap is not likely to contain gases of compositions and in quantities which affect the processes of manufacture and properties of the product. VSP (25)

Determination of Oxygen, Nitrogen and Hydrogen in Steel. J. G. Thompson (U. S. Bureau of Standards). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 466, Feb. 1932, 22 pages.

Bibliography of 64 references. A review of the various methods that have been used in determining O, N and H in steel. The interpretation of the results of the various methods are also discussed. It is pointed out that the question of particle size must be considered in relationship to the applicability of the various methods. H is rarely encountered in ferrous materials in excess of about 0.001%. N can be determined by the solution-distillation method or by vacuum fusion. No one method yields complete information with respect to the O in steel. JLG (25)

Hydrogen Absorption of Some Metals at Various Temperatures. (Die Wasserstoffaufnahme einiger Metalle bei verschiedenen Temperaturen.) Thews. *Die Metallbörse*, Vol. 21, Apr. 25, 1931, page 774.

Discusses and tabulates the H_2 absorption of Al, Cu, Co, Ni, Pt, Ag, Sn at elevated temperatures. EF (25)

Critical Studies of a Modified Ledebur Method for Determination of Oxygen in Steel. B. M. Larson & T. E. Brower (United States Steel Corp.). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 28 pages.

The H-reduction method for the determination of O in steel determines the "diffusible O," which portion is probably effective in modifying the properties of the steel. An improved apparatus by which the amount of diffusible O to within 5 or 10% can be determined is described. The water formed is collected in a weighing tube. The CO and CO_2 formed are made to react with H to form CH_4 by a Ni-Th catalyst. This catalyst, when properly handled, is not poisoned and does not give a large blank. Thin millings are used, and the surface O is removed by a preliminary heating in H at 500-550° C. The sample is heated to 1100-1300° C. in the H. Boats made of pure MgO or ZrO_2 give a rather large blank. Samples can be wrapped in steel foil and suspended in the furnace. The fraction of O evolved as CO or CO_2 varies from 15-25% in ingot iron to almost 100% in high-C steel. Comparative O contents as determined by the apparatus described and by the vacuum fusion method at the Bureau of Standards are given. In some of the low-O steels the O determined by the modified Ledebur method is much greater than the "total O" determined by vacuum fusion. A tool steel analyzed 0.018% O by the former method and 0.004% by the latter. When more O was present (0.025%) however, good checks were obtained. Comparative results on N determined on the same steels by the ordinary solution-distillation method and by vacuum fusion at the Bureau of Standards are also given: the agreement is satisfactory. 17 references. JLG (25)

Influence of Small Amounts of Impurities on Properties of Refined Zinc. O. Bauer. *Metal Industry*, London, Vol. 39, Dec. 25, 1931, page 613.

From paper read before Deutsche Gesellschaft für Metallkunde, Berlin. The shrinkage of Zn is lowered by Cd, Sn, and Mg, whereas Cu, Fe, and Pb have no appreciable effect; Sb is intermediate between these two groups in its effect. The impact value is improved by large percentages of Sn, is little affected by Cd and Pb, and is unfavorably affected by Fe, Mg, and Sb. The Brinell hardness is rapidly raised by Mg, but by Cu and Fe to a lesser degree; it is similarly affected by small additions only of Sb and Cd, whereas Pb and Sn have no effect. PRK (27)

The Effect of Sulphur on the Molten Equilibrium $Fe + NiSiO_3 \rightleftarrows Ni + FeSiO_3$. (Die Wirkung von Schwefel auf das schmelzflüssige Gleichgewicht $Fe + NiSiO_3 \rightleftarrows Ni + FeSiO_3$.) H. zur Strassen. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 200, Aug. 28, 1931, pages 46-56.

The reaction of this composition shows that in the presence of sulphur the equilibrium is changed a little in so far as the distance in the potential series between Fe and Ni becomes smaller and that the reaction follows the ideal mass law. Ha (27)

Scrap. *Metallurgist*, Dec. 1931, pages 179-180.

The question whether scrap shall or shall not be used in the production of non-ferrous metals emphasizes once more the inadequacy of present testing methods and the monumental lack of knowledge we possess of the effect of impurities or of other elements. VVK (27)

Action of Oxides on Pt at High Temperatures. (Über die Einwirkung von Oxyden auf Platin bei hohen Temperaturen). E. J. Kohlmeyer & I. Westermann. *Siebert Festschrift*, 1931, pages 193-214.

The effects of Bi_2O_3, PbO, MgO, Al_2O_3, as well as of silicates, like Marquardt mass, on Pt at various temperatures and of MgO on Rh are described and photographs and micrographs shown. Attack appears to begin when the dissociation pressure of PbO or Bi_2O_3 reaches 3×10^{-2} mm. Hg. Even with the refractory oxides, attack of Pt appears to coincide with an appreciable decomposition pressure of the oxide. It is not clear whether actual reduction of the oxide by Pt is involved. HWG (27)

Micro-Structure and Tendency Towards Brittleness of Lead. (Kristallgefüge und Disglomeration des Bleies.) O. Haehnel (Reichspostzentralamt). *Elektrische Nachrichten Technik*, Vol. 8, Feb. 1931, pages 77-88.

Pb cable sheaths which failed in service precipitated the present investigation on 11 different analyses of Pb to throw light upon the effect of additions of Sn, Sb, Bi, Cu, Zn on the grain size of Pb after solidification. The following observations were made: the largest crystals were noticed in the purest kind of Pb employed (99.997% Pb). However Pb containing 1-3% Sn did not exhibit a substantially smaller grain size after solidifying under analogous testing conditions. The grain size of "pure" Pb was reduced by the different metals studied as follows: 1% Bi = 2/3 reduction, 1% Sb = ¾, 1% Zn = ⅞ and 0.1% Cu = ⅞. Every kind of Pb extruded from a cable press showed a smaller grain size than solidified Pb. However, the purest brand of Pb again exhibited the largest grain. The effect of the additions was approximately the same as in the solidification tests except in case of Sb which caused a more pronounced reduction in grain size after extruding. The grain size of Pb extruded in a cable press depends on undeterminable friction phenomena in the die, on the manner and speed of cooling down after extrusion and on the working temperature and pressure applied. Grain growth of extruded or cold worked Pb is extremely slow at ordinary temperatures. A distinct acceleration of recrystallization takes place at only 40° C. Shocks, for instance vibrations of traffic, result in recrystallization at room temperatures, the rate of grain growth increasing for 5-7 times after 20 years at 18° C. Exposure to the sun rays increased the size of the crystals 10-12 times after 1-1½ years elapsed. Sn (1.3%) and Sb (1%) strongly counteract the formation of coarse grain of extruded Pb cables and 0.1% Cu also reduce the tendency towards recrystallization. The tendency to become brittle, designated as "disglomeration" by the investigator, is not a direct cause of large grain size. This phenomenon is mainly due to vibrations although being more pronounced in coarse grained Pb than in finely crystalline one. The embrittlement is accelerated by rising temperatures. Cracking due to vibrations takes place in Pb with 3% Sn although the grain size corresponds to that of freshly extruded Pb cable sheets. 19 micro-photographs. EF (27)

The Influence of Small Quantities of Aluminum on the Structure of Antifriction Alloys of Sn, Pb, Cu, Sb Rich in Tin. (Influence de petites quantités d'aluminium sur la structure des alliages antifrictions Sn, Pb, Cu, Sb riches en étain). M. Fournier. *Revue de Métallurgie*, Vol. 29, Feb. 1932, pages 108-111.

Micrographic study of 3 alloys with 3% of Cu and Pb containing 5.6 and 8.6% Sb shows that in Sn base antifriction alloys the addition of small quantities of Al (around 1%) produces a pronounced liquation, eliminates cubical crystals of the solid solution and causes a fine globular structure on rapid cooling. JDG (27)

A Study on the Influence of Nickel on the Properties of Lead Bronzes. (Contribution à l'Etude de l'Influence du Nickel sur les Propriété des Bronzes au Plomb.) J. Dessent. *Revue Universelle des Mines, de la Métallurgie*, Series 8, Vol. 7, Feb. 1, 1932, pages 99-102.

The ternary system Pb-Cu-Sn is investigated. Due to its difficult miscibility it often does not give satisfactory castings. A thermal treatment at 700° C. is proposed which gives Cu-Sn surrounded by a pseudo-eutectic Pb-Cu. The addition of 1 to 2.5% Ni adduced considerable improvements in grain and uniformity of structure. Numerous micrographs illustrate the difference due to the addition of nickel in various bronzes. A table of physical data is added. Ha (27)

INSTRUMENTS & CONTROLLERS (28)

An Improved Comparison Source for Measuring Furnace Temperatures. E. M. WATSON & W. P. ZABEL. *General Electric Review*, Vol. 35, Feb. 1932, pages 120-121.

A small pyrometer lamp has been devised that differs from an optical pyrometer in that the objective lens and the telescope are not used. The optical system for the pyrometer lamp and the optical pyrometer are charted for comparison. The operation of the lamp is briefly outlined. WHB (28)

Design Features of Potentiometers. I. MELVILLE STEIN. *Engineering & Mining Journal*, Vol. 132, Apr. 1932, pages 254-256.

Low-resistance potentiometers are shown to have the following advantages over high-resistance types: (1) inherently a low-resistance potentiometer makes possible a higher sensitivity, (2) errors due to current leakage between the potentiometer parts are smaller, (3) low-resistance coils are more stable, (4) power galvanometer damp'ng is easier to obtain, (5) at least 1/10 of the range can be covered with a slide wire resulting in simple and inexpensive construction, and (6) for the same sensitivity, and a low-resistance potentiometer permits using a higher resistance in the volt-box. WHB (28)

A Continuous Gas Indicator. *Industrial Chemist*, Vol. 8, Feb. 1932, pages 57-58.

A new design of instrument (B.P. 330799) developed by the Admiralty Research Laboratories. Its action depends upon the comparison of the viscosity-density properties of the gas under test against air in a specially constructed bridge. Diagrammatic layout is shown. RAW (28)

A New Spectral Line Photometer for the Visible Field for the Rapid Analysis of Alloys. (Über ein neues Spektrallinienphotometer für das sichtbare Gebiet zur Schnellanalyse von Legierungen.) G. SCHEIBE & G. LIMMER. *Metallwirtschaft*, Vol. 11, Feb. 19, 1932, pages 107-110.

Contains 6 references. A new apparatus made by R. Fuess in Berlin-Steglitz, which is a combination spectroscope and spectrophotometer. From an ordinary rigid spectroscope with adjustable slit diaphragm the light rays pass through a Wollaston plate, which divides them into 2 beams polarized vertically to one another. The 2 spectra can be observed through a Nikols prism and by turning the prism the intensity of the spectra can be compared. To determine alloy additions or impurities in steel the sample is used either as electrodes for sparks or as the positive electrode for an arc, carbon being used as the negative electrode. By turning the Wollaston plate, which also turns the Nikols prism, and by adjusting the spectroscope slit, a line corresponding to the element to be determined can be moved exactly above an Fe line and their intensity compared. The instrument must first be calibrated, using chemically analyzed samples and choosing suitable lines for each element. The accuracy for quantitative analysis is not as great as in chemical methods, except when very small percentages are determined. The main advantage is the speed of determination, about ½ hour for a complete quantitative analysis of all elements and only a few minutes for qualitative tests. CEM (28)

Thermo Elements (including Rhenium alloys) and the Reproducibility of Their Data. Criteria for Their Utility for Temperature Measurements. (Über Thermoelemente und die Reproduzierbarkeit ihrer Daten -Kriterien für ihre Brauchbarkeit zur Temperaturmessung). W. GOEDECKE. *Siebert Festschrift*, 1931, pages 72-99.

The thermal e.m.f. of alloys of Pt with Ru, Fe, Ta, Os, Re, W, Mo and V, against pure Pt are plotted for different percentages of alloying element, and compared with the usual Pt-Rh or Pt-Ir alloys. Some properties of Pt-Re with up to 10% Re are shown. Brinell hardness rises from 40 for Pt to 180 for the 10% Re alloy. An 8% Re, Pt-Re alloy has an e.m.f. of 35 m.v. at 1300° C. against Pt, or over twice that of the usual thermocouple. One of 4½% Re, 5% Rh, has 30 m.v. at 1300°C. A couple of Rh vs Rh — 8% Re, though giving but about 7 m.v. at 1800° C., is usable up to 1900° C. Loss of weight on heating at 1300° C. is rather high in the 8% Re alloy, but not bad in the 4½% Re, 5% Rh alloy. Cu-Ni, Cu-Ni-Fe, Cu-Ni-Mn-Fe, Ni-Cr, and Ni-Cr-Fe elements are dealt with. A couple of 12.5% Ni, 87.5% Cu vs 20% Ni, 80% Cu has nearly the same e.m.f. as the standard Pt — Pt-Rh couple. Segregation in Ni-Cr and Cu-Ni ingots is discussed. HWG (28)

Some Studies in Pyrometry and on the Radiation Properties of Heated Metals. R. HASE. *Proceeding Physical Society*, London, Vol. 43, Mar. 1, 1931, pages 212-216.

In measuring the spectral energy radiated by solid and liquid metals at high temperature ideal black body conditions are seldom existent so that some sources of error in the methods of pyrometric measurements must always be expected. The conditions are discussed and some experiments described which were made to find the degree of agreement of measurement and values required by theory. Ni and Pt were among the metals used in the experiments. Ha (28)

Pyrometers in Blast Furnace Practice. CHARLES E. FOSTER. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 141-147, 153.

A rather complete discussion of the various types of instruments available for the measuring of temperatures about a plant. The advantages and disadvantages of the instruments are set forth, together with a recommendation of the maximum temperature to which each type should be subjected. Expansion thermometers, electrical pyrometers, resistance pyrometers, thermo-electric pyrometers, and optical and radiation pyrometers are considered. CHL (28)

Remote Control of Voltage Regulators of Plating Baths. (Fernsteuerung von Spannungsreglern galvanischer Bäder.) HUETTER. *Oberflächentechnik*, Vol. 9, Feb. 16, 1932, page 33.

The voltage of the galvanizing generator can be regulated by a magnetic regulator on the machine which is operated by a push-button on each bath so that a change in voltage due to change in load can be compensated directly. Ha (28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Effect of Temperature on the Properties of Nitrided Alloys. OSCAR E. HARDER (Battelle Memorial Institute). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 631-657.

For abstract of paper see *Metals & Alloys*, Vol. 2, Oct. 1931, page 231. In the discussion additional short-time test data are tabulated on an alloy containing 0.30% C, 0.42 Mn, 0.09 Si, 0.67 Ni, 1.21 Cr, 1.31 Al, and 0.18 Mo. The tests made up to temperatures of 1400° F., were on a specimen of 0.253" diameter. A total of 180 hours' treatment produced a 1/16" case, comprising approximately ½ of the total cross sectional area. Nitrided bars show greater strength, yield point and proportional limit at the high temperatures than is obtained on the heat treated unnitrided material. On the other hand, from 70° up to 800° or 900° F. the strength properties of the nitrided bars are shown to be decidedly inferior. A comparison is made of the modulus of elasticity up to 1000° F. on nitrided and unnitrided material. WAT (29)

Nickel and Nickel Alloys Other Than the Nickel-Chromium-Iron Group. C. A. CRAWFORD & ROBERT WORTHINGTON (International Nickel Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 557-588.

For abstract of paper see *Metals & Alloys*, Vol. 2, Sept. 1931, page 192. In the discussion additional short-time test data are tabulated and shown graphically on admiralty nickel (70 Cu, 29 Ni, 1 Sn) and compared with Monel metal (70 Ni, 30 Cu) between 70° and 1400° F. WAT (29)

Thermal Conductivity of Tin at Low Temperatures. W. J. DE HAAS, S. AYOAMA & H. BREMMAR. *Proceedings Academy Science, Amsterdam*, Vol. 34, Jan. 31, 1931, pages 75-77.

Experiments were made on a rod of pure Sn, 9 cm. long and 1.8 mm. in diameter at 9 temperatures between 97° and 12.5° K. The energy input was measured electrically and the temperatures were measured with a gas thermometer and a Pt resistance thermometer. Because of the indefinite form of the contacts at the extremities of the rod, the values of the coefficient of thermal conductivity in absolute units could not be calculated accurately. Results are given for the "thermal resistance" of the rod. This decreases steadily as the temperature is lowered and the value at 12.5° K is less than ¼ that at 97° K. The curve has a point of inflection at about 15° K and agrees essentially with the results of Gruneisen and Goens. WHB+WAT (29)

On Crystal Deformations under Large Pressures and Elevated Temperatures. (Ueber Deformationen an Kristallen bei erhöhtem Druck und erhöhter Temperatur.) F. HEIDE (University of Jena) *Zeitschrift für Kristallographie*, Vol. 78, June 1931, pages 257-278.

A testing equipment designed for the study of crystals exposed to large pressures (19,000 atmospheres max.) and to elevated temperatures (430° C. max.) is described. EF (29)

The Effect of Temperature on Some of the Physical Properties of Metals. F. C. LEA & C. F. PARKER. *Engineering*, Vol. 133, Jan. 1, 1932, pages 23-26; Jan. 8, 1932, pages 54-55; *Engineer*, Vol. 152, Oct. 2, 1931, page 255 (abstract).

The object of the research is to consider the phenomenon and methods of measuring creep in relation to temperature and stress. The authors have used two methods for determining creep, (1) in which a specimen is subjected to either tension or compression, more generally the former, and (2) the specimen is subjected to a constant torsional stress. Diagrams of the apparatus are included, as well as a detailed description of the test methods. The steel studied was one containing 0.45% C, 14% Cr, 9% Ni, and 3.5% W. The temperatures of test were room temperature, 475°, 500°, and 610° C. The results of short-time tension tests, creep tests, and a special torsional-creep test are presented in tabular as well as graphic form. Izod impact values and Vickers hardness values are also given between the temperatures of 20° and 700° C. for the alloy steel and three low carbon low alloy steels. At temperatures above 500° C. mild steels not only show a low "limiting creep stress" or a low stress for 10^{-7} in./in./hr. creep, but they show a considerable tendency to intercrystalline corrosion and oxidation of the pearlitic areas, and consequently distinct changes in impact values at room temperature. With the special alloy steels that are now being made, the risk of scaling and intercrystalline corrosion at 500° C. is reduced to a minimum, but continuous creep may take place in shear at 500° C. at stresses of 2 tons/in.^{2}, corresponding to simple tensile stress of 4 tons/in.^{2} LFM + WAT (29)

Thermal Expansion of Metals. NORMAN L. MOCHEL. (Westinghouse Electric & Mfg. Co.). *Symposium on Effect of Temperature on Metals, A.S.T.M.—A.S.M.E. Joint Research Committee*, 1931, pages 683-724.

For abstract of paper see *Metals & Alloys*, Vol. 2, Oct. 1931, page 232. In discussion from the Detroit Edison Company is emphasized the fact that the engineer should not be called on to convert expansion coefficients or other constants from the metric into the English system. The physicists in compiling the data should set forth the constants in terms the engineer could readily use. Expansion coefficients should be tabulated both in Centigrade and Fahrenheit temperatures. The National Fire Protection Association states that more attention should be given to the effect of fires and conflagrations upon structural steel and other metals employed in the construction and found among the contents of buildings and other structures that may be exposed to accidental fire. It is suggested that unequal expansion during a fire may cause more damage than loss of strength. In considering some of the so-called heat-resistant alloys for building purposes, it appears well to point out that many such alloys have considerably higher rates of expansion than ordinary steel, and that although increased strength might be attained by their use the problem would be much aggravated by their increased rate of expansion. WAT (29)

Effect of Elevated Temperatures on Certain Mechanical Properties of Gray Cast Iron and Malleable Iron. J. W. Bolton (Lunkenheimer Company) & Hyman Bornstein (Deere and Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 436-465.

For abstract of paper see *Metals & Alloys*, Vol. 2, Sept. 1931, page 192. In the discussion the Crane Company states that up to 750° F. there is no measurable growth in cast iron. The range between 750° and 900° F. is apparently where growth commences. The Worthington Pump and Machinery Corporation in the discussion presents data obtained at Battelle Memorial Institute on short-time tensile and long-duration creep tests on 3 cast irons, a gray iron, a high-test iron (2.5% Si) and a Ni iron (1.5% Ni). In the short-time tests, reported to 1500° F., the three irons hold their original strength well up to 700° F. At this temperature the high-test iron shows superiority, having about 50,000 lbs./in.^{2} tensile strength. The Ni iron follows with a strength of about 45,000 lbs./in.^{2} and the gray iron next with about 35,000 lbs./in.^{2} at 700° F. In the creep tests at 700° F. and under a load of 10,500 lbs./in.^{2} the deformation rate slowed down almost to zero well before 2000 hours had elapsed on the high test and Ni irons and the curves presented show that the gray iron had also slowed down almost to zero; the creep rate on the latter iron being of the order 0.0000003 in./in./hr. After 2015 hours under load at 700° F. the bars were removed from the creep test apparatus and subjected to tension tests at room temperature. There was practically no change in the tensile properties. The Brinell hardness had been reduced from the original value about 6% for the high-test and Ni irons, and about 20% for the gray iron. Thermal expansion data on these irons are also presented. The coefficient of expansion per ° F. between 100° and 1000° F. for all three irons is the same, namely 0.0000076. (As far as the abstractor is aware this is the most complete collection of data on the short-time tension and creep characteristics of cast irons at elevated temperatures available in the published literature). WAT (29)

On the Influence of Temperature on the Elastic Behaviour of Various Wrought Light Metal Alloys. Franz Bollenrath (Aerodynamisches Institut, Technische Hochschule, Aachen). *Institute of Metals, Advance Copy* No. 588, Apr. 1932, 14 pages.

Strong Al and Mg alloys were tested at temperatures between —190 and +180° C. All were wrought, and were tested in tension. Extreme care was used in maintaining the specimens at the desired temperature during testing. All specimens were held at the testing temperature for 110 hr. before testing in order that no further changes in the structure would take place during testing. Round specimens 10 mm. in diameter with a 100 mm. gage length were used. Elongation was measured with a Martens optical extensometer. The modulus of elasticity decreased regularly with increasing temperature in some alloys, but maximum values were observed at room temperatures in Silumin and Lautal. It is suggested that the Si causes the maxima in these curves. The moduli for the various alloys at 20° C. were:

Alloy	Modulus of Elasticity kg./mm.^{2}
Duralumin 681 B	7050
Duralumin 681ZB	7180
Scleron	6880
Silumin	6650
Constructal 2	6950
Constructal 87	7100
Elektron AZM	4270
Elektron Vlw	4280

Values of elastic limit were also obtained. These values are based on permanent elongations of 0.001, 0.01 and 0.03%. 7 references. JLG (29)

Creep of Steel Under Simple and Compound Stresses and the Use of High Initial Temperature in Steam Power Plant. R. W. Bailey. *Transactions Tokyo Sectional Meeting, World Power Conference*, 1929, Vol. 3, 1931, pages 1089-1121.

Design of plant for high temperature service should be based upon the permissible changes in dimensions and materials. A creep rate of 10^{-8} tensile strain per hour should be considered as a working limit. Structural changes occurring in C steel at present common working temperatures, that is, spheroidization of cementite, are apparently the same as is known to occur at higher temperatures but in less time. Preliminary tests indicate that in a 0.9% C steel spheroidization of cementite reduces the stress for a given rate of creep about 25%. A smaller reduction in stress is to be expected in steels of lower C content. Further research on this is desirable. In order to retard structural changes in boiler parts subjected to strain hardening in manufacturing, annealing of these parts is essential. Oxidation must not be overlooked. Torsion creep tests may be taken to indicate that creep by shear at a plane is uninfluenced by the normal stress acting upon that plane. By means of this hypothesis creep under different straining actions may be correlated. Thin cylindrical tubes under torsion are found to correspond with thin tubes under internal pressure. While there is evidence that creep by shear may be regarded as general, the alternate torsion and tension tests made by the author at 480° and 550° C. indicate that the behavior at these temperatures is different. Deductions made in accordance with the tests upon steel tubes and the hypothesis suggested above, receive confirmation from tests upon Pb pipes under internal pressures. Unless there is superimposed axial stress, pipes, tubes, etc., may be expected to creep only in the direction of the diameter. Any loading upon a steam pipe due to thermal expansion whether giving rise to a direct load or a bending moment, will relieve itself under operating conditions by creep and the stresses corresponding with the full thermal expansion will occur when the system is cold. All these conclusions are illustrated graphically. The torsional creep apparatus is described and illustrated. See also *Metals & Alloys*, Vol. 1, Oct. 1930, page 795. WAT (29)

Measurements of the Electrical Resistance of Pure Indium, Thallium and Gallium at Low Temperatures of the Magnetic Disturbance of the Superconductivity of Thallium. W. J. De Haas & J. Voogd. *Proceedings Academy of Sciences, Amsterdam*, Vol. 34, Jan. 31, 1931, pages 51-55.

Results are given for measurements on several samples of very pure In and Tl at temperatures in the neighborhood of the boiling point of He. Indium becomes supraconducting at 3.37° K and Tl at 2.35° K. For Ga the ratio R/R. is 0.2625 at 90.55° K and 0.00031 at 4.25° K. It becomes supraconducting between 1.07 and 1.05° K. Data are given showing the effect on the supraconducting of Tl of longitudinal magnetic fields ranging from 28.3 gausses to 128.4 gausses. The value of the magnetic field for which, in an increasing field, the resistance is restored to half of its normal value is plotted against temperature and compared with the results of De Haas, Sizoo and Onnes for Hg. While the graph for Hg is straight above 3° K and curved below that temperature the graph for Tl is curved at all temperatures below the transition temperature. WHB+WAT (29)

Heat Resistance of Plain Carbon Steel. (Resistance a Chaud des Aciers Ordinaires.) L. Guillet, J. Galibourg & M. Samsoen. *Aciers Speciaux, Metaux et Alliages*, Vol. 6, July 1931, pages 353-354; *Genie Civil*, Vol. 98, May 2, 1931, page 455.

See *Metals & Alloys*, Vol. 2, Oct. 1931, page 232.
GTM+Ha (29)

Hollow Forged Vessels for High Temperatures and Pressures. Ronald Benson. *Metallurgia*, Vol. 5, Feb. 1932, pages 131-132.

Describes the large forged vessels produced by the English Steel Corp. and methods used in their production. Ingots weighing as much as 170 tons are required. The center is either machined out of the cold annealed ingot or punched from the hot ingot. In the latter case the material is not below a red heat until the forging is completed. Bottle neck ends may be produced by swaging. Either plain C or alloy steels are used. Steels containing Mo have been found to have high creep limits at temperatures between 400 and 500° C. JLG (29)

Heat Emission From Iron and Copper Pipe. F. C. Houghten & Carl Gutberlet. *Heating, Piping & Air Conditioning*, Vol. 4, Jan. 1932, pages 47-52.

Data are presented on the heat emission from bare Fe and Cu pipe under service conditions at various temperatures resulting from a study made at the Research Laboratory of the American Society of Heating and Ventilating Engineers in coöperation with the Associated Copper Tubing Manufacturers. A few data are included giving heat emission for galvanized Fe, brass and Al pipe, and the effect of paint on the surface of the pipe on the rate of heat emission, and the reduction in heat emission from standard iron pipe resulting from the application of commercial insulation. The heat loss from bare Cu pipe is approximately 54% of the loss from bare black Fe pipe of the same nominal size, and 203% of the loss from Fe pipe covered with 4-ply air cell insulation. The heat loss is approximately the same for horizontal and vertical pipe of the same size and material. WAT (29)

Effect of Low Temperatures on Metals and Alloys. H. W. RUSSELL, (Battelle Memorial Institute). *Symposium on Effect of Temperature on Metals, A.S.T.M.—A.S.M.E. Joint Research Committee,* 1931, pages 658-682.

For abstract of paper see *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. In the discussion several exceptions are taken to the conclusions and generalizations made in the paper. In certain metals and alloys (Cu, Al, and Ni and some of their alloys) it is quite reasonable to expect increased ductility or toughness or both to accompany the increased hardness produced by the lowered temperature, rather than a decrease as stated in the paper. Additional short-time test data are tabulated on cold rolled Cu, Ni, naval brass, nickel silver, annealed nickel silver, and forged aluminum bronze at boiling liquid air temperature and room temperature. A probable relation in carbon and low-alloy steels between microstructure and change in elongation and reduction of area upon lowering temperature is indicated. In boiling liquid air these changes with heat treatment are occasionally large. WAT (29)

High Pressure Steam. F. H. ROSENCRANTS. *Transactions Tokyo Sectional Meeting, World Power Conference,* 1929, Vol. 3, 1931, pages 873-897.

Reviews the present stage of development of steam generation and utilization, with particular reference to increased pressure and temperatures, and points out that although a number of noteworthy installations are operating at pressures and temperatures far in advance of normal practice, no uniformity of opinion yet prevails as to the economic advantages that are being realized. It is pointed out that advantages in temperature are limited by the physical characteristics of the materials of construction. Above a temperature of 750° F. a field is entered where preconceived ideas of stress, usually adopted by designers, are no longer valid, due to the phenomenon of creep taking place in all materials maintained at high temperatures. This condition lowers considerably the safe working stress. A lessening interest is predicted in high pressure and further progress in the direction of temperature. Limiting creep stresses and elastic moduli values are compared graphically for Armco Fe and various C steels for temperatures up to 1000° F. WAT (29)

The Effect of Temperature on Some Properties of Iron-Chromium-Nickel Alloys. N. B. PILLING & ROBERT WORTHINGTON (International Nickel Company). *Symposium on Effect of Temperature on Metals, A.S.T.M.—A.S.M.E. Joint Research Committee,* 1931, pages 495-556.

For abstract of paper see *Metals & Alloys,* Vol. 2, Oct. 1931, page 231. In the discussion the statement is made that the terms "18-8" and "35-15" as applied to Ni-Cr alloys are meaningless so far as indicating the probable performance of a specific sample under given conditions. Elements such as C, Si, and Mn exert profound influence upon the character of the alloy and its performance in practical service. It is to C and Si that cast iron owes its superiority to mild steel in heat resistance and corrosion resistance. Mn also affects the strength and corrosion resistance. There is, however, an optimum quantity of these three elements in combination with Ni and Cr that produce the most satisfactory results. The wide variation in results reported by different investigators on supposedly the same material is probably due to some extent to the lack of control the less predominant elements in the melting furnace. In another discussion it is stated that the use of heat-resisting alloys would be increased tremendously if it were possible to use thinner sections in castings. The very large factor of safety necessary in some sections undoubtedly makes these parts too heavy. Much of the existing data on the properties of metals at elevated temperatures is of questionable utility, principally because of incomplete information regarding the history of the material prior to testing. It is strongly urged that sponsor societies set up through their various committees standardization of test bar preparation, standardization of test methods and systems of checking reliable short-time proportional limit data against long-time creep data. Further tests should be developed to indicate the relative cleanliness of cast alloys. The general opinion of the majority of the discussers seems to be that the paper indicates certain prominent gaps in the present knowledge of the high-temperature behavior of alloys. More information is needed on the properties of castings at higher temperatures, and on the effects of corroding media, other than oxygen, in these high temperature ranges. Short-time tension test data are tabulated for an alloy of 80% Ni, 13 Cr, 6 Fe, 0.12 C, 1 Mn, 0.01 Cu and S and 0.1 Si between the temperatures 70° and 2200° F. WAT (29)

Accidents to Water Tube Boilers in Service (Les accidents de tubes de chaudières aquatubulaires en service). GASTON PARIS. *Chaleur et Industrie,* Vol. 138, Oct. 1931, pages 507-516.

The question of materials for the construction of boilers has, in recent years, received considerable attention. Not only has there been a call for the study of the qualities of the resistances of these materials to temperatures and pressures, but metallurgical problems have been raised that have not met the satisfactory approval of every one. It is more particular, above pressures of 88 lbs. that super-heat temperatures of 450° C. are theoretically used. But in actual service, it is not known how metals resist for very long times, and with absolute safety a temperature of super-heat of 500° to 550° C. Also for pressures of the order of 220 lbs. it is necessary to limit the temperature of super-heat to 440° C. It is also a matter of considerable importance that research produce metals having the necessary qualifications and not have a price that prohibits their use. For many years, binary and ternary alloys have been susceptible to oxidation when used for super-heater tubes, in the presence of gases at a temperature of 500° C. For this reason, many metals have been rendered unsatisfactory. The problem is not limited to boiler tubes. Piping and valves must also resist high temperatures. In different degrees, the same question is what metals should constitute boiler materials. The researches of Babcock and Wilcox are reviewed, and a number of typical examples of boiler corrosion and oxidation are presented in photographs and micrographs. WAT (29)

Chromium Steels for High Heat Resistance. (Ein Beitrag zur Kenntnis Hoch Hitzebeständiger Chrom Stähle.) MAX SCHMIDT & OTTO JUNGWIRTH. *Archiv für Eisenhüttenwesen,* Vol. 5, Feb. 1932, pages 419-426.

The applicability of high heat resistant steels, in range of 700° to 1300° C. is shown by their resistance to ignition loss, strength and tenacity under heat, mechanical stability during continuous work at elevated temperatures, and price. 17 different steels, Cr 18-32%, C 0.12%-1.72%, and varying proportions of Mo, W, Co and V were studied. The behavior of these steels on continuous work at elevated temperatures is shown to be of especial importance and differences are to be noted between cast and forged materials. In the forged state, the steels with 22% Cr and approximately 0.3 to 0.55% O_2 give best results up to 1000° C., while above this temperature the tenacity of all tested specimens is lost rather quickly; small additions of W, Mo, V and Co produce no advantages in this respect. In the cast condition temperatures above 1000° C. do not cause unfavorable results, and at 1100° C., under repeated annealing the bend resistance actually increases. The structure of 22% Cr-steels was thoroughly studied and practical behavior of these steels is explained by the type of structure. In the application of heat resistant steels in forged state, temperature limits of continuously worked material were determined, while with cast metal, resistance towards ignition loss is given. Steels containing 30% Cr are preferable for cast parts, while for forged pieces, steels with 22% Cr appear to be better. Numerous diagrams and data compiled to illustrate results. DTR (29)

The Hardness of Metal Alloys at Different Temperatures. Die Härte der Metallegierungen bei verschiedenen Temperaturen.) W. SCHISCHOKIN & W. AGEJEWA. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 193, Oct. 21, 1930, pages 237-244.

The relation of the temperature coefficient of the hardness of those binary systems which do not form intermetallic compounds was investigated; from the measurements on Bi-Sn, Bi-Cd, Pb-Cd, Sn-Cd, Pb-Zn, Sn-Zn and Zn-Cd, the curve of the temperature coefficient at different temperatures of the hardness could be represented by the equation

$$a = \frac{\log H_2 - \log H_1}{t_2 - t_1}$$

where H_2 and H_1 are the values of hardness at temperatures t_2 and t_1 respectively. In all systems, except Sn-Cd, the eutectic alloy has highest temperature coefficient. Ha (29)

Copper Embrittlement. L. L. WYMAN (General Electric Co.). *American Institute Mining & Metallurgical Engineers, Preprint,* 1931, 11 pages.

Embrittlement of various coppers resulting from heating in an oxidizing atmosphere followed by heating in a reducing atmosphere was studied. A number of temperatures for both atmospheres were used. The coppers investigated included: tough pitch, vacuum melted, and those deoxidized with calcium boride, Si, Si plus P, and Zn. Sheets 0.060 in. thick were used, and the embrittlement was followed by microscopic examination. The coppers were rated in the following order with respect to their resistance to embrittlement: Zn deoxidized, Si deoxidized, calcium boride deoxidized, vacuum treated, Si and P deoxidized, and tough pitch. There were many variations in materials that had supposedly received same deoxidizing treatment. 9 references. JLG (29)

The Selection and Testing of Materials for Highly Stressed Chemical Apparatus. (Die Werkstoffrage und Werkstoffprüfung bei hochbeanspruchten Chemischen Apparaten.) ERNST FRANKE. *Die Chemische Fabrik,* Vol. 4, Mar. 25, 1931, pages 133-135.

Steel used for chemical apparatus must not become brittle after aging, must retain its strength at elevated temperatures, must not corrode easily and must be free from caustic embrittlement. Among steels which meet these requirements are Izett steel, low C-V or Mo cast steel and 3-5% Ni steels. When a stronger steel is used for construction the sections can be correspondingly reduced. Metals used for chemical apparatus should be thoroughly tested. In addition to the usual tests impact tests before and after artificial aging should be made. The aging consists of a 10% cold reduction followed immediately by heating to 250° C. for ½ hour. The difference in impact due to aging should be slight. Long time tensile tests at elevated temperatures and creep limit determinations should also be made. High grade testing machines are required for making these tests. CEM (29)

Magnetic Disturbance of the Superconductivity of Single-Crystal Wires of Tin. W. J. DE HAAS & J. VOOGD. *Proceedings Academy of Science, Amsterdam,* Vol. 34, Jan. 31, 1931, pages 63-69.

Single crystals of Sn approximately 15 mm. long and from 0.15 to 0.25 mm. in diameter were studied at low temperatures, in both transverse and longitudinal magnetic fields. The results in general resembled those previously observed in Hg. That is (a) there is a hysteresis effect in that the resistance reappears at a higher value of the magnetic field than that for which it disappears as the field is reduced; and (b) there are discontinuities in the resistance-magnetic field curve. At 2.92° K when the field is applied longitudinally it is possible to observe a transition state between the normal resistivity and the supraconductivity as the field is increased, but the resistance vanishes abruptly as the field is diminished. This vanishing does not always occur at the same field intensity, but the value is always less than the field for which the resistance appears. At 2.89° K when the field is applied transversely, the effects are quite different. A gradual increase in field produces a gradual increase in resistance, starting at H = 64 gausses, and becoming constant at about H = 102 gausses. Increasing H to 214 gausses produces no appreciable change in resistance. As H is decreased, the resistance remains constant until H is approximately 95 gausses, when the resistance vanishes abruptly. The exact values in the transverse effect depend to some extent upon the current used in measuring the resistance, but the longitudinal effect seems to be independent of the current strength within considerable limits. The character of the magnetic transition figure seems to be independent of the orientation of the crystal axis with respect to the axis of the wire. A graph is given showing the effect of temperature on the field intensity at which the resistance is restored in the longitudinal effect. WHB (29)

The Temperature Shift of the Transmission Band of Silver. J. V. Pennington. *Physical Review,* Vol. 39, Mar. 1932, pages 953-956.

It is shown that by Kronig's quantum theory of dispersion in metals the shift of the frequency at which maximum transmission is found for Ag when the temperature is varied from -269° to +254° C. can be explained. The calculated rate of shift is in agreement with experiment. WAT (29)

Determinations of the Creep Characteristics of Metals on Heating (Sur la dètermination des caractéristiques d'allongement visqueux des métaux à chaud). Georges Ranque & Pierre Henry. *Genie Civil,* Vol. 99, Dec. 1931, pages 630-631; *Comptes Rendus,* Vol. 193, Nov. 1931, pages 1061-1063.

An accelerated creep testing apparatus similar to that developed by Rohn (See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 27) has been constructed and the creep characteristics of Armco iron have been determined according to the three following methods; (1) measuring as a function of time the decreasing load required to maintain constant elongation under constant temperature, (2) measuring as a function of time the elongation under constant load and temperature, and (3) measuring as a function of time the temperature at which no creep occurred under constant load. A diagram and description of the apparatus is presented. Elongations of 1.58% at 550° C., 0.65% at 475° C. and 0.003% at 400° C., under a load of 6 kg./mm.^{2}, are reported for Armco iron based on a creep rate of 0.005% per 100 hours and extrapolated to 10,000 hours. OWE+WAT (29)

A Photographic Creep Testing Apparatus. D. A. Roberts & R. L. Dowdell (Univ. of Minnesota). *Metals & Alloys,* Vol. 2, Dec. 1931, pages 349-351.

The authors describe apparatus for creep testing in which the creep is recorded photographically. 2 Pt gage wires are attached to the specimen 2" apart. To one of the gage wires, a Pt strip 3/16" wide bent to conform to the contour of the test specimen is attached; the strip is 2" long and the gap between it and the other gage wire is periodically photographed with suitably arranged camera. The Pt strip is embossed with lines a definite distance apart for determining the magnification of any particular photograph. Lantern slide negatives of the gap allow, by projection on a screen, any desired magnification of the creep. The claims for the apparatus are that it takes a creep measurement directly on the specimen without effect of deflection in other parts of the equipment and without effect of heat. The record is permanent and free from personal error and is capable of any desired degree of accuracy. WLC (29)

Tensile Properties of Rail Steels at Elevated Temperatures. G. Willard Quick (U. S. Bureau of Standards). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 25 pages; *Bureau of Standards Journal of Research,* Vol. 8, Feb. 1932, *Research Paper* 408, pages 173-189.

Tensile tests at temperatures up to 700 or 750° C. were made on 28 specimens of new and used rails from 18 different heats. The materials represented differences in composition and different rates of cooling on the hot beds. It was found that the secondary brittleness at 400-700° C. was an inherent property of rail steel. It is suggested that slow cooling through the secondary brittleness range improves the ductility of rails. New and used rails containing shatter cracks were examined, and there was some indication that shatter cracks were nuclei for transverse fissure formation. There was no appreciable difference in strength or ductility at elevated temperatures between transverse-fissured rails and rails that had been subjected to the same service without fissuring. Sorbitic rails had marked secondary brittleness. Medium Mn rails also had a pronounced secondary brittleness. 3 references. JLG+WAT (29)

High Temperature Resistor Uses Iron-Base Alloy. Correspondence from E. Oehman, Stockholm, Sweden. *Metal Progress,* Vol. 20, Dec. 1931, page 78.

The writer describes the heat resisting properties of an iron base alloy, which is marketed under the name of Kanthal, containing Cr, Al and Co which has a melting point of 3000° F. and resists scaling up to 2400° F. Resistance is 15-20% higher than best Ni-Cr alloys. Furnace element run 500 hrs. at 2375° F. and subjected to a maximum temperature of 2450° F. showed no deformation and only slight oxidation. WLC (29)

The Resistance to Impact of Rail Steels at Elevated Temperatures. G. Willard Quick. *Bureau of Standards Journal of Research,* Vol. 8, Feb. 1932, *Research Paper* 409, pages 191-198; *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 10 pages.

Charpy impact tests were made in the temperature range 20° to 700° C. on V notch specimens cut transversely and longitudinally from a medium Mn rail, and on longitudinal specimens cut from 2 standard rails, one cooled normally and the other slowly after leaving the hot saw, 2 heat-treated rails and 1 untreated comparison rail, and a commercial bar stock steel containing 0.60 % C. The energy absorbed in breaking the specimens from all these materials increased as the temperature increased from 20° to about 400° C., then decreased to a minimum at about 600° C., after which it increased rapidly to 700° C. Tensile tests on the rail steels, reported previously, had shown a marked decrease in elongation and reduction of area for all of the rail steels between 400° and 700° C., with the minimum values at 550° or 600° C., but not for the bar stock. The tensile test had also shown somewhat higher ductility in the secondary brittle range for the slowly cooled rail and the heat-treated rails than for the normally cooled and the untreated comparison rail, but the impact test did not distinguish between them. The path of the fractures in the impact specimens was transcrystalline at all temperatures. It is believed that the minimum values for impact strength occurring at 550° or 600° C. may be ascribed to the same phenomenon as the low ductility disclosed by the tensile tests at the same temperatures, namely, that of secondary brittleness rather than to the phenomenon of blue brittleness which some believe occurs at a higher temperature in dynamic tests than in tensile tests. WAT+JLG (29)

Some Physical Properties of Wiping Solders. D. A. McLean, R. L. Peek & E. E. Schumacher. *Bell Telephone System Technical Publications,* Monograph B-641, 1932, 25 pages.

The plasticity of a number of solders at wiping temperatures has been determined by compression tests between parallel plates. The character of the flow is found to be that corresponding to a linear relation between shearing and a fractional power of the velocity gradient. This corresponds approximately to a relation between rate of compression (dh/dt) and sample height (h) given by the equation: $dh/dt = kh^b$, in which K and b are constants, of which b is independent of the test conditions. For viscous materials b = 5.0; for most solders b is greater than 5.0, and increasing values of b are associated with the lower temperature gradients of plasticity. It is shown that a solder must have a low temperature gradient of plasticity in order to be properly wiped, and that determination of the value b by means of a plasticity test can therefore be used to evaluate the working properties of a solder. A number of factors upon which the plasticity of wiping solders and the porosity of wiped joints may depend have been investigated. In particular, it is shown that segregation is not responsible for porosity, but that the latter may be dependent upon the particle size of the solid phase at wiping temperatures. The relation of particle size to the wetting power of the liquid phase is discussed. WAT (29)

High-Chromium Steels for Extreme Service Conditions. C. E. MacQuigg (Union Carbide and Carbon Research Laboratories). *Symposium on Effect of Temperature on Metals, A.S.T.M.—A.S.M.E. Joint Research Committee,* 1931, pages 589-609.

For abstract of paper see *Metals & Alloys,* Vol. 2, Oct. 1931, page 231. In the discussion it is emphasized that steels containing 4-6% Cr have given satisfaction in oil still tubes where excellent resistance has been offered to the high-sulphur crude oils, notably in the Texas fields. Additional short-time test data are tabulated for a steel containing 0.17% C and 5.44 Cr. These results indicate a yield point of approximately 65,000 lbs./in.^{2} at 1200° F. Steels in the group of 4-6% Cr show marked plastic yielding before failure. This ability to "hang on" in service gives ample warning to avert accident. These steels also have air hardening properties. This characteristic, however, while sometimes of advantage presents difficulties in flanging, welding and similar operations. The addition of W and Mo promises to benefit the creep resistance of such steels. WAT (29)

Resistance of Steels to High Temperatures. (La Résistance des Aciers aux Températures Élevées). André Michel. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Nov. 1931, pages 536-546.

A general review of present status of knowledge on the properties of steels in service at high temperatures. GTM (29)

The X-Ray Examination of Aluminum at High Temperatures. A. J. Alichanow. *Zhurnol Prikladnoi Fiziky,* Vol. 6, 1931, pages 19-22.

Al was investigated with X-rays in order to test whether it showed an allotropic transformation between the temperatures 575° and 600° C. It was found that its structure, being that of a face-centered cube, remained unchanged. Thus far the same line system was observed independently of the previous treatment, but no measurements had been made at the higher temperatures. See also *Metals & Alloys,* Vol. 1, Aug. 1929, page 75. WAT (29)

Red Shortness of Steel in Contact with Other Metals. H. Schottky, K. Schichtel & R. Stolle. *Iron Age,* Vol. 128, Dec. 24, 1931, page 1607.

An abstract translation of an article in *Stahl und Eisen,* Vol. 51, June 18, 1931. A description is given of the development of red shortness in steels of 0.10-1% C. at temperatures of 1500°-2200° F. as influenced by contact with other metals. Comparisons are made by hot-bend tests with the powdered contact metal distributed over the tension side of the specimen. In general, metals causing red shortness are completely miscible with iron in the liquid state, but have limited solubility in solid iron. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 193. VSP (29)

Effect of Temperature upon the Charpy Impact Strength of Die-casting Alloys. Bert E. Sandell (Stewart Die Casting Corp.). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 4 pages.

Made Charpy impact tests on 2 Zn-base alloys and 2 Al-base alloys at temperatures from 0 to 500° F. Standard A.S.T.M. specimens were used. The Zn alloys contained 4% Al, 3% Cu and 0.1% Mg. One set represented present practice and the other set a prior practice. The Al alloys contained 5 and 11.5% Si. The impact strength of the Zn alloys varied with the temperature. They were brittle at low temperatures and became less brittle as the temperature rose. The alloys representative of present practice had higher values at all temperatures. No appreciable variation in impact resistance was found in the Al alloys in the temperature range investigated. JLG (29)

Apparatus for Low-temperature Endurance Testing. H. W. Russell & W. A. Welcker, Jr. *Proceedings American Society for Testing Materials,* Vol. 31, Pt. 1, 1931, pages 122-128.

See abstract of preprint. *Metals & Alloys,* Vol. 2, Nov. 1931, page 283. HWG (29)

Creep of Materials and Creep Stresses—II. Jas. Cunningham. *Steam Engineer,* Vol. 1, Mar. 1932, pages 269-270.

General review. AHE (29)

Note on Applications of Data on the Thermal Conductivity of Metals. M. S. Van Dusen (Bureau of Standards). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee,* 1931, 725-733.

For abstract of paper see *Metals & Alloys,* Vol. 2, Oct. 1931, page 203. In the discussion there is given from the Bureau of Standards a graph showing the change in thermal conductivity with increase in temperature to 600° C. for chemically pure (99.95%) Zn, graphite, high-purity (99.94%) Ni, malleable (99+%) Ni, gray cast iron, eutectoid steel, 1% W steel, high-purity (99.9%) Pb, 15% Cr steel, 17% Cr steel, 1.5% Al steel and a 12% Mn—3% Ni steel. The conductivity of these materials as compared with each other decreases in the order listed. WAT (29)

MANUFACTURERS' LITERATURE REVIEWS

436 **Deoxidizers for Steel**—Bulletin SM-1 of the Electro Metallurgical Co., New York, N. Y., describes the deoxidation of steel with silicon-manganese alloys, its mechanism and practical applications.

437 **Instruments for Spectrographic Analysis**—A 45-page booklet compiled by the Bausch & Lomb Optical Co., Rochester, N. Y., gives general information on quartz spectrographs, spectrography in the analytical laboratory, sector photometry and a description and prices of their instruments.

438 **Cadmium Plating**—The July 1932 issue of Udylite News, published by the Udylite Process Co., Detroit, Mich., contains a full description and illustrations of the new Udylite laboratories. A pamphlet published by the same company describes their new plating barrel with hard rubber cylinder.

439 **Stainless Steel Motor**—A leaflet published by the Lincoln Electric Company, Cleveland, Ohio, is devoted to their Stainless Steel, Type E Induction Motor. Construction features are given.

440 **Relays**—Leaflet GEA-1583 issued by the General Electric Co., Schenectady, N. Y., is given over to a discussion of their electric relays. A few types are listed and described.

441 **Grinding**—The June issue of Grits & Grinds, published by the Norton Co., Worcester, Mass., features an article entitled "Cylindrical Grinding of Hollow Work—Tubes, Pipes."

442 **Enamels**—A leaflet discussing their acid-resisting enamel for sheet metal as well as cast iron has been issued by the Ferro Enamel Corporation, Cleveland, O.

443 **Electric Furnaces**—The Pittsburgh Electric Furnace Corp., Pittsburgh, Pa., has sent out reprints of an article entitled "The Manufacture of Acid Electric Steel and Cast Iron." Two interesting bulletins issued by the same company are, G1—The 'Lectromelt Process for Gray Iron Castings and SC—The 'Lectromelt Process for making Steel Castings.

444 **Hot Strip Reels**—Bulletin N-301 of the United Engineering & Foundry Co., Pittsburgh, Pa., presents a survey of the best available machines for the reeling, coiling, winding, re-winding, re-coiling and coil-opening of hot-rolled metal strips.

445 **Dowmetal**—The Dow Chemical Co., Midland, Mich., has prepared a number of data sheets giving the composition and uses of their magnesium alloys, their mechanical properties and the sizes in which bars, angles, channels and tees of these alloys can be furnished. The sheets are punched for binding.

446 **Wire Cloth**—Catalog No. 32 of the Newark Wire Cloth Co., Newark, N. J., is practically a handbook on wire cloth containing 100 pages of information on the subject. Wire cloth of stainless steel, Monel metal, nickel, copper, bronze, manganese steel, silver, gold, platinum, etc., are listed. A novel feature is a glossary of wire cloth terms.

447 **Steel**—A new issue of the Ryerson Journal and Stock List has just been published by Joseph T. Ryerson & Son, Chicago, Ill. This handy reference book on steel, in addition to complete general descriptions, specifications, sizes, etc., contains the new extras on bands, the new cold finished steel extras, the new hot rolled cutting extras, and other information of value to the steel user.

448 **Forge Furnaces**—A recent circular sent out by the Surface Combustion Co., Toledo, Ohio, discusses the application of diffusion combustion to forging operations. Descriptions and operating data are given.

449 **Beryllium**—The Brush Laboratories Co., 3715 Euclid Ave., Cleveland, Ohio, has recently issued a price list covering beryllium compounds furnished by them.

450 **Everdur**—A pamphlet prepared by the American Brass Co., Waterbury, Conn., is devoted to their Everdur metal, a high strength weldable material, as applied to rust-proof tanks. It gives the properties and characteristics of Everdur and the capacities of Everdur tanks of various dimensions.

451 **Seamless Pipe**—The National Tube Co., Pittsburgh, Pa., has sent out a price list of their 4%-6% chrome seamless pipe and still tubes.

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ALPHABETICAL INDEX TO ADVERTISERS

452 **Cold Strip Reels**—Bulletin P 203 issued by the United Engineering & Foundry Co., Pittsburgh, Pa., is devoted to their cold strip reels for the reeling, coiling, winding, blocking, rewinding and uncoiling of cold-rolled metal strips in rolling mill work, from flat wires and narrow ribbons up to the widest sizes, tension from 100 lbs. to over 100,000 lbs.

453 **Arc Welding**—The Hobart Brothers, Troy, Ohio, have issued a leaflet describing their portable welder and power plant combined.

454 **Better Castings**—The August issue of this bulletin of the Niagara Falls Smelting & Refining Corp., Buffalo, N. Y., contains paragraphs discussing their special pattern aluminum alloy, their nickel shot for grey iron, and several alloys of nickel and chromium with grey iron.

455 **Electric Immersion Units**—Leaflet TB-30 issued by the Harold E. Trent Co., Philadelphia, Pa., gives the prices of the various types of electric immersion units for heating liquids, waxes, etc.

456 **Furnaces**—The Ajax Electrothermic Corp., Trenton, N. J., is distributing two reprints of articles which appeared recently. One is entitled "Four Ton Coreless Induction Furnace Installed" and gives a description of the installation and operation of a 4-ton Ajax-Northrup coreless induction furnace. The other, "Vacuum Casting," describes a special adaptation of the use of the high frequency induction furnace for melting and pouring metals under vacuum.

457 **Bearing Metal**—A recent number of the *Dutch Boy Quarterly*, published by the National Lead Co., New York, N. Y., features an article on "Satco," a new and improved bearing metal. Results of tests on this alloy are given, but not its analysis.

458 **Grinding Wheels**—The July-August issue of *Grits & Grinds*, published by the Norton Co., Worcester, Mass., features an article entitled "Judging Relative Merits of Different Wheels for Grinding." Another interesting article in the same issue is "End Surfaces and Flanges Ground with Angular Wheel Slide Grinding Machine."

459 **Arc Welder**—A recent bulletin of the Harnischfeger Corp., Milwaukee, Wis., describes in detail the construction and operating advantages of the P & H-Hansen arc welder manufactured by them. Of particular interest is the description of the "Internal Stabilizer" which eliminates weight and extra equipment and gives an assurance of a more uniform flow of current.

460 **Copper**—Some unusual and interesting applications of copper and brass are described in the July 15th issue of the Bulletin published by the Copper & Brass Research Association, New York, N. Y.

461 **Furnaces**—Bulletin F of the Pittsburgh Electric Furnace Corp., Pittsburgh, Pa., discusses a few of the outstanding features of the Moore Rapid 'Lectromelt furnace. Bulletin GK of the same company gives a description of the operation of a 1½ ton per hour 'Lectromelt furnace.

462 **Electric Belt Conveyor Furnace**—An illustrated 4-page leaflet has been published by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., which describes the applications and uses of this type of equipment.

463 **Stainless Steel Sheets**—An unusually attractive 23-page pamphlet has just been issued by the American Sheet & Tin Plate Company, Pittsburgh, Pa. It discusses the types of stainless and heat resisting steel sheets and light plates manufactured by the company, giving the chemical analysis, physical properties and fabrication of each type. Suggestions for welding stainless steel sheets are given.

464 **Circuit Breakers**—Oil-blast circuit breakers for use on circuits up to 15,000 volts and 2,000 amperes are now available. They are described in leaflets GEA-959D and GEA-1601 sent out by the General Electric Company, Schenectady, N. Y.

465 **Lead**—The September issue of this publication of the Lead Industries Association, New York, N. Y., illustrates a number of interesting applications of lead, among them being a new type of hand wrought lead grilles, lead anti-vibration pads and lead lining for garden pools.

GENERAL (0)

Practical Importance of Specifications for Materials. H. H. Morgan (Robert W. Hunt Co.). *Metal Progress,* Vol. 21, Jan. 1932, pages 38-42.

The writer stresses the importance of purchasing material by specifications and urges wider use of standard specification. WLC (0)

Selecting Steel Intelligently. H. E. Mack. *Machine Design,* Vol. 4, Feb. 1932, pages 32-34.

General viewpoints for the selection of steels for various purposes; even high first cost may make economies possible. 10 typical S. A. E. steels with pieces and characteristic properties are tabulated. Ha (0)

Logical Organization can cut Waste Losses. A. D. Maxwell. *Canadian Foundryman,* Vol. 23, Feb. 1932, pages 9-10.

A brief description of methods that can be adopted for the speeding-up of production and for its control. OWE (0)

Iron and Steel Metallurgy in 1931. Clyde E. Williams & James L. Gregg (Battelle Memorial Institute). *Mining & Metallurgy,* Vol. 13, Jan. 1932, pages 27-29.

In field of ore concentration attention was given to the more difficultly separated wash ores; some progress made in tabling. Advances made on application of froth flotation to iron ores. Improvements made in automatic control of combustion in open-hearth furnaces. Work of C. H. Herty, Jr. on killed steel was devoted to plant studies of the Bureau of Mines recommended method for deoxidation. The electrolytic method for determining inclusions in steel was developed. Progress made in development and commercial application of high test cast Fe. Most interesting investigations of Fe alloys dealt with alloys that undergo no allotromorphic transformation. Extensive studies made of Fe-Mg alloys of high purity. Embrittlement of structural steels resulted in development of reliable methods for detecting embrittlement. VSP (0)

The Chemical Elements and Atomic Varieties according to the Status of the Isotope Investigations. Report of Investigations from the End of 1930 to the End of 1931. (Die chemischen Elemente und Atomarten nach dem Stande der Isotopen-Forschung. Bericht über die Arbeiten vom Ende 1930 bis Ende 1931.) O. Hahn. *Berichte der Deutschen Chemischen Gesellschaft,* Vol. 65, Jan. 6, 1932, pages 1-11.

A review, including 42 references, of the mass spectroscopic results on Li, B, Zn, Ge, Se, Br, Sr, Ru, Sn, Sb, Te, Cs, Ba, W, Re, Os, Tl and U, and the band spectroscopic results on Li, Be, B, O, N, Cl and Tl. A table is included giving the number and atomic weights of isotopes. CEM (0)

Mitteilungen der deutschen Materialprüfungsanstalten. Sonderheft 18. Julius Springer, Berlin, 1931. Paper, 8¼x11¾ inches, 83 pages. Price 16 RM.

Contains 10 articles, by Bauer, Sachs, Schmid, Boas, Wasserman and co-workers on plasticity of crystals, X-ray and electron diffraction measurements, Ag-Cu alloys, testing of cast iron, growth of cast iron, properties of As and Sb crystals, etc. The individual articles are abstracted in *Metals & Alloys.* H. W. Gillett (0) -B-

General View Points on the Patentability of Alloys. (Allgemeine Gesichtpunkte für die Patentfähigkeit von Legierungen.) F. Herzfeld-Wuesthoff. *Zeitschrift für Elektrochemie,* Vol. 37, Aug.-Sept. 1931, pages 517-520; *Die Metallbörse,* Vol. 21, June 13, 1931, page 1111.

A discussion of the definitions and regulations of the German Patent Office influencing the patentability of alloys according to whether they are chemical compounds or simply mixtures. Ha + EF (0)

Because It's Tested, Millions Travel Safely. H. F. Moore (Univ. of Illinois). *Steel,* Vol. 88, Jan. 22, 1931, pages 38, 40.

A popular article on the role of the testing engineer in advancing civilization and the value of his chemical and physical tests in contributing to the comfort, safety, leisure, convenience and prosperity of mankind. JN (0)

The New International Society of Testing Materials. (Nya Internationella Materialprovningsföreningens kongress den 6-12 Sept. 1931.) Gunnar Malmberg. *Jernkontorets Annaler,* Vol. 115, Dec. 1931, pages 607-625.

General review. HCD (0)

Metallurgical Fundamentals, Present and Future. Charles C. Maier. *Metal Industry,* London, Vol. 29, Aug. 21, 1931, pages 173-174, 176; Aug. 28, 1931, page 200.

Paper presented before the A. I. M. M. E., Sept. 1931. See *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 55. PRK (0)

Metal Research. (Metallforschung.) Oswald Bauer. *Aluminium,* Vol. 14, Jan. 31, 1932, pages 1-2.

The development and purposes of metallographic research are briefly discussed. Ha (0)

Magnetic Materials in the Year 1931. T. D. Yensen. *Engineering,* Vol. 133, Feb. 19, 1932, page 235.

See *Metals & Alloys,* Vol. 3, May 1932, page 115. LFM (0)

Science in Action. E. R. Weidlein. *Journal Society of Western Engineers,* Vol. 37, Feb. 1932, pages 1-7.

A condensed report of the first lecture of a series before the Society for 1931-32 pictures developments of interest principally to engineers. The work of the Institute at Pittsburgh, Pa. is described in prefacing a discussion of improvements effected in petroleum and rubber products, new uses for by-products, fuel saving, smoke elimination, food supplies, etc. See also *Metals & Alloys,* Vol. 3, May 1932, page MA 115. WHB (0)

A Textbook of Metallurgical Problems. Allison Butts. McGraw-Hill Book Company, Inc., New York, 1932. Cloth, 6 x 9 inches, 425 pages. Price $4.00.

This book fills a very definite need, which no doubt has been recognized by every metallurgical instructor, who used Richard's "Metallurgical Calculations" as a text. In spite of the excellence of Richard's book, metallurgical progress in the ensuing years since the publication of the first edition have disclosed a number of errors and rendered portions of the book obsolete. Butts' book presents a large number of problems designed to accompany courses in metallurgy. It gives examples of methods used in calculation and contains tables supplying the necessary data. Richard Rimbach (0) -B-

PROPERTIES OF METALS (1)

Changes in Electrical Resistance Due to Magnetism and Hardness. S. R. Williams & R. A. Sanderson. *Physical Review,* Vol. 37, Feb. 1931, pages 309-314.

A series of 22 rods or strips of Ni, to which had been imparted different degrees of hardness by cold rolling, had their resistance measured when subjected to a longitudinal magnetic field. There were 11 degrees of hardness, 2 samples for each degree. The longitudinal magnetic field increased the resistance in all cases. The different degrees of hardness did not vary the specific resistance of the Ni, but it did cause a large variation in the change of resistance due to a magnetic field. The measurements were carried out at a constant temperature of 35° C. WAT (1)

The Permeability of Iron, Nickel and Cobalt between 10^6 and 10^7 Cycles. (Die Permeabilität von Eisen, Nickel und Kobalt zwischen 10^6 und 10^7 Hertz.) M. J. O. Strutt. *Zeitschrift für Physik,* Vol. 69, April 13, 1931, pages 632-658.

The tests were made at these frequencies between a few tenths and a few Gauss. In this range, the permeability of the 3 metals decreases slowly with increasing frequency; anomalies as previously assumed to exist at 100 m. wave length could not be confirmed. Heat treatment of the Fe does not show any influence. Ha (1)

On the Conductivity of Thin Metal Foils. (Ueber die Leitfähigkeit von dünnen Metallfolien.) Ladislaus Tisza. *Naturwissenschaften,* Vol. 19, Jan. 23, 1931, pages 86-87.

It is suggested that tests already made on the conductivity of foil should be augmented by others made at very low temperatures, as the critical thickness below which the conductivity decreases very rapidly is much greater at low temperatures than at room temperature. WHB (1)

The Magneton Numbers of Ferromagnetic Materials. (Ueber die Magnetonenzahlen ferromagnetischer Stoffe.) A. Wolf. *Zeitschrift für Physik,* Vol. 70, July 14, 1931, pages 519-538.

An attempted explanation of the magneton numbers of ferromagnetic elements permits a calculation of the magneton number which agrees well with the observed facts above the Curie point. Ha (1)

Electrical Resistance of Nickel and Iron Wires as Affected by Longitudinal Magnetic Fields. O. Stierstadt. *Physical Review,* Vol. 37, 1931, pages 1356-1366.

The previous work of McKeehan (*Physical Review,* Vol. 36, page 948) and Vilbig (*Archiv für Electrotechnik,* Vol. 22, 1929, page 194) is discussed, and new experiments on the change of resistance of Ni and very pure Fe in longitudinal magnetic fields of low magnitude are described. In the absence of secondary effects, the magnetic field always increases the resistance. The anomalous results of previous workers are due chiefly to incomplete demagnetization of the specimens before each measurement; even the effect of the earth's field may cause errors, and another factor is the presence of soldered joints within the magnetic field. The change of resistance over the whole cycle of magnetization need not show a loop unless the magnetization curve shows hysteresis, and with pure Fe the loop diminishes at high temperatures. The saturation of the change of electrical resistance in magnetic fields occurs at much lower field strengths in ferromagnetic than in normal metals, and it is shown that this can be explained in a general way by the Frank-Sommerfeld theory (*Zeitschrift für Physik,* Vol. 60, 1930, page 682; *Physical Review,* Vol. 43, 1930, page 438; Vol. 44, page 473). WAT (1)

Optical Investigations of Thin Metallic Layers, Particularly of Silver. (Optische Untersuchungen von dünnen Metallschichten, insbesondere bei Silber.) W. Reinders & L. Hamburger. *Recueil Travaux Chimiques Pays-Bas,* Vol. 50, Mar. 15, 1931, pages 351-376.

Previous experiments on the light-absorption powers and ultra-microscopic photography of thin metallic films particularly of Ag deposited in high vacuum were continued. The Ag layers were obtained from Ag wire electrically heated under vacuum of about 10^{-6} mm. Thuringian glass was used as the base material for the deposit. The structure of the films depends on the thickness of the layer, the temperature at which the layer is deposited and the base material. Thicknesses of about 2 atoms of Ag are the limit for layers detectable with the naked eye. An investigation was also made of layers of Cd, W and Hg deposited in a vacuum. The mean grain size was smaller with decreasing mobility of the atoms. Ha (1)

On the Energy Content of Lead near the Supra-Conductivity Break Point. (Über den Energieinhalt des Bleies in der Nähe des Sprungpunktes der Supraleitfähigkeit.) K. Mendelssohn & F. Simon. *Zeitschrift für physikalische Chemie,* Section B, Vol. 16, Feb. 1932, pages 72-76.

An apparatus based on the Linde principle is described which is suited for calorimetric measurements down to 2° abs. with a sensitivity of 0.005°. The equipment was used for plotting heating curves of Pb. Around the break point of supra-conductivity, no abnormal change of the energy content was observed. EF (1)

Certain Photoelectric Properties of Gold. Lloyd W. Morris. *Physical Review,* Vol. 37, 1931, pages 1263-1268.

The photoelectric behavior of a Au filament was studied both during an extended outgassing and later on reaching a stable condition. Full arc sensitivity rose quickly in the initial outgassing period, then decreased slowly to a stable value. Fatigue curves show a systematic change from negative fatigue at the beginning to a gradually increasing positive fatigue which slowly decreased to 0. A shift in long-wave limit consistent with the change in full arc sensitivity was observed. Changes in the photoelectric properties were produced by increasing temperature. Full arc sensitivity decreased slightly. Individual line sensitivity was studied by use of a quartz monochromator. Lines close to the long-wave limit increased enormously in sensitivity with temperature; for those more removed this was less marked; below 2350 A.U. there was a slight decrease. A shift in the long-wave limit toward the red was observed during the outgassing period, and the final fatigueless state. During this latter period curves of photoelectric current per unit light intensity established a shift in long-wave limit from 2560-2610 A.U. between temperatures of 20° and 740° C. WAT (1)

Beryllium, Its Production and Application. Issued by the Zentralstelle für Wissenschaftlich-Technische Forschungsarbeiten des Siemens-Konzerns. Translated by R. Rimbach and A. J. Michel. Chemical Catalog Co., New York, 1932. Cloth, 6¼ × 9¼ inches, 331 pages. Price $10.00.

This is a translation of some two dozen separate articles by a score of authors, which appeared in *Wissenschaftliche Veröffentlichungen a. d. Siemens Konzern,* Vol. 8, No. 1, 1928, reporting the intensive work of the Siemens Company in the preceding five years. An extended correlated abstract of the German publication was given in the August 1929 vol. 1, pages 71, 72, issue of *Metals & Alloys.* It is the main source of information on the preparation of beryllium and its alloys with Cu, Fe and Ni, the bulk of the book relating to the Cu-Be alloys.

The precipitation-hardening phenomena met in these alloys are of great metallurgical interest in relation to the theories involved so that the book might almost as well be entitled "Principles of Precipitation-Hardening." The alloys themselves, by suitable heat-treatment, may be given over 200,000 lbs./in.^{2} tensile strength in wrought material and 125,000 in cast material, remarkable values for a corrosion-resisting non-ferrous alloy.

To make such important information as is contained in this volume available in English by translation, is a distinct service. Whether the interest lies in the scientific facts relating to precipitation hardening, the production and analyses of the alloys, or in the possibilities of commercial application of the alloys described, the book will be of value to the metallurgical engineer, chemist, and executive.

The library of the reviewer's organization paid $9.20 for an unbound copy of the German text, so that the price of the bound English edition is less than that for a bound copy of the German one. H. W. Gillett (1) -B-

Commercial Gallium. *Chemical Trade Journal & Chemical Engineer,* Vol. 90, Mar. 4, 1932, page 242; *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 22, Feb. 7, 1932, page 76.

Quotes *Chemiker-Zeitung* and *Nature* to the effect that the Vereinigte Chemische Fabriken at Leopoldshall, Stassfurt, are producing metallic gallium at 1/20 of its former price of 175 gold marks/gram. The pure metal melts at 20° C. but boils above 2000° C. Some proposed uses are in quartz thermometers for temperatures from 500°-1000° C., in dental amalgams, and in optical mirrors, signalling devices, electric fuses and vapor arc-lamps. JN + GN (1)

Experiments with Silicon (Untersuchungen an Silizium). A. Schulze. *Zeitschrift für technische Physik,* Vol. 11, No. 11, 1930, pages 443-452.

The electric resistance of several kinds of Si up to close to the melting point is determined. Polycrystalline Si shows the normal behavior of semi-conductors; while single crystals are entirely non-metallic, they have a positive temperature coefficient. The latter depends on the layers between the crystallites and their number. The resistance curves up to 1000° C. show clearly that no transformation points exist. A further corroboration is seen in the fact that Si possesses a cubic face-centered lattice both at 18° and at 950° C. Ha (1)

Volatile Thallium and Lead Hydride. (Flüchtiges Thallium und Bleihydrid.) E. Pietsch & F. Seuferling. *Die Naturwissenschaften,* Vol. 19, July 26, 1931, page 574.

TlCl and $PbCl_2$ films were treated with atomic H and the occurrence of the metal hydrides was proved. EF (1)

Chromium. General Information. Lewis A. Smith. *United States Bureau of Mines Information Circular* 6566, Apr. 1932, 31 pages.

A review is given of properties, occurrence, uses, marketing, tariffs, world trade, world production, world resources and political and commercial control. AHE (1)

The Properties of Copper in Relation to Low Stresses. The Effects of Cold-Work, Heat-Treatment, and Composition. Part I.—Tensile and Compression Tests Under Short-Time Loading. O. F. Hudson & J. McKeown. *Institute of Metals, Advance Copy* No. 594, Apr. 1932, 20 pages.

Hot-rolled Cu rods were cold drawn to a reduction of 5 or 10%, and annealed or aged at temperatures between 100° and 400° C. Careful tensile tests proved that such treatment raised the proportional limit of the Cu without appreciably affecting other properties. Coppers containing As, Ag, As plus Ag, and Sn plus Si were also tested. The addition of these elements increased the proportional limit, and in material containing As plus Ag or Sn plus Si the proportional limit was not lowered by heating to 300 or 350° C. Tensile and compression tests at 300 and 350° C. proved that these materials were more resistant to deformation at these temperatures than pure Cu. Cu containing 0.3-0.5% As and 0.1% Ag had a proportional limit of 6.6 tons/in.^{2} after having been held at 200° C. for 100 hr. It is concluded that "the marked superiority of the properties which have been shown to be readily achieved by pre-treatment should warrant the attention of engineers and other users of Cu where resistance to deformation under low stresses is of importance, as it is in so many applications." 6 references. JLG (1)

Vanadium. Frank L. Hess. *United States Bureau of Mines, Information Circular* 6572, Apr. 1932, 8 pages.

A general discussion is given of the occurrence, resources and uses of V. AHE (1)

Electrical Conductivity and Optical Absorption in Metals, once more. Edwin H. Hall. *Proceedings, National Academy of Science,* Vol. 17, June 1931, pages 392-401.

Drude's equation of motion of an electron within a metal is discussed with particular reference to "free" and "associated" electrons. The conduction electrons mentioned by Meier may reasonably be taken to be associated electrons. J. J. Thomson's formula $(k \sin^2 nT)/n^2T^2$ applied to transit conductivity gives the same results as those obtained by the author in a different way. The work of Meier and of Hager and Rubens on absorption conductivity is reviewed and discussed. 6 references. Ha (1)

Materials and Load. (Werkstoff und Anstrengung.) Franz Laszlo. *Stahl und Eisen,* Vol. 52, Feb. 25, 1932, pages 189-192.

Theoretical discussion of notch sensitivity with respect to form of materials. The method for calculating measurement theory against change in form is described and research work necessary to obtain these results is given. DTR (1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

The Role of Platinum Metals in Dental Alloys. E. M. Wise, Walter S. Crowell & J. T. Eash (International Nickel Co. and S. S. White Dental Mfg. Co.). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 44 pages.

38 references. The binary alloys Ag-Cu, Au-Ag, Au-Cu, Pd-Au, Pd-Ag, Pd-Cu, Pt-Au, Pt-Ag, Pt-Cu, and the ternary systems Au-Ag-Cu and Pd-Ag-Cu are discussed. The diagrams are given, and the properties of the alloys, including their mechanical properties, color, tarnish resistance and ease of melting and working are described. Particular attention is called to the age-hardening properties of some of these alloys. In the second part of the paper the properties of some Pt- and Pd- containing alloys suitable for dental applications are discussed. Results of tests on some of these alloys are also included. Some of these alloys possess a broad age-hardening range. Considerable saving can result by using Pt or Pd in some Au-base dental alloys. JLG (2)

Progress Report on Research on Dental Material (1931). N. O. Taylor & G. C. Paffenbarger. *Journal American Dental Association,* Vol. 19, Mar. 1932, pages 404-409.

A progress report of the coöperative research inaugurated in 1928 by the National Bureau of Standards and the Research Commission of the American Dental Association. The work during 1930-1931 has included studies of amalgams for dental use, inlay golds, and wrought golds. A list of 33 publications giving data on dental research conducted at the National Bureau of Standards is quoted from Bureau of Standards Letter Circular 239. Specifications for the following dental materials have been prepared: (1) Amalgam alloys; (2) inlay casting investments; (3) impression compounds; (4) inlay wax; (5) three types of inlay casting golds; and (6) dental mercury which is included in this report. A plan has been inaugurated, whereby manufacturers of dental material may have their products certified. A list of 28 amalgam alloys from 19 manufacturers, 5 inlay casting investments, 4 impression compounds, and 2 inlay waxes which have been certified is given. The future research program includes wrought golds, clasp and one-piece casting golds, and dental cements. OEH (2)

Alloys of Pd with Pt and with Rh (Ueber die Legierungen des Palladiums mit Platin und mit Rhodium). G. Tammann & H. J. Rocha. *Siebert Festschrift,* 1931, pages 309-320.

Sketchy data on hardness of the Pt-Pd alloys when quenched and after reheating, together with some comments on structure and on the absorption of cathodic hydrogen. The hardness was maximum at 50 atomic % and at that composition was not affected by the heat treatment. With less than 50 atomic % Pd the alloys quenched from 1400° and 1200° C. were harder than those reheated to 600°, and those quenched from 1400° C. were notably harder than those quenched from 1200° C. The hardness of Pt-Rh alloys after a 1200° C. anneal is given, showing a maximum at 50 atomic %. HWG (2)

Tin Base Bearing Metals. (Zinnlagermetalle.) Thews. *Die Metallbörse,* Vol. 21, Nov. 7, 1931, pages 1961-1962; Nov. 14, 1931, pages 1993-1994; Nov. 21, 1931, page 2026.

Requirements to be met with by bearing metals. 12 advantages of bearing metals on Sn base as compared with bearing metals rich in Pb. Two tables of the A.S.T.M. collecting various physical properties of Sn and Pb alloys at room and elevated temperatures respectively are included, and the effect of Cu, Ni, Fe and Zn is considered. Four sources of trouble responsible for the failure of bearing metals are stated in conclusion. EF (2)

A Study of Wrought Gold Alloys: Preliminary Report. N. O. Taylor, G. C. Paffenbarger & W. T. Sweeney. *Journal American Dental Association,* Vol. 19, Mar. 1932, pages 410-414; Discussion pages 414-415.

This report relates largely to test methods which are to be used in research. The alloys which were used in the preliminary work had the following compositions:

Alloy	A	B	C
Gold	63.2	57.6	54.6
Copper	11.3	11.7	12.3
Pt metals	10.6	26.5	24.5
Silver	14.9	4.3	7.1

The alloys were softened by heating 10 minutes at 700° C. and quenching. They were then hardened by reheating to 450° C. and cooling to 250° C. in 30 minutes. Specimens 0.04 in. in diameter and having a 2 in. gage length have been adopted. The deformation is read by a double dial extensometer reading to 0.0001 in. Hardening increased the strength of all of the alloys and was most pronounced in alloy C. The results of tensile tests are given. OEH (2)

The Alloys of Silver and Copper (Sur les alliages argent-cuivre). W. Broniewski & S. Koslacz. *Comptes Rendus,* Vol. 194, Mar. 14, 1932, pages 973-975.

The authors have investigated the relationship between the constitution of this system and 15 different physical constants and have represented the results of their work upon a series of curves which accompany their paper. They find the eutectic of the system to contain 71% Ag and to freeze at 779° C. The maximum solid solubility of Cu in Ag they find to be 7%; that of Ag in Cu, 6%. These solubilities are somewhat less than those noted by Stockdale in his 1931 work. Physical and mechanical properties were studied on alloys cast in graphite crucibles in a cryptol furnace and fabricated into wires 5 mm. in diameter. These were annealed for 12 hours at 650° C. in CO_2. The measures adopted in measuring the various properties have been described by the authors on previous occasions. The authors discuss their work in the light of the work of other investigators. The fact that some precipitation hardening can occur in solid solutions containing less than the maximum percentages of solute metal is referred to. Mention is also made of the fact that the alloys, when prepared in a reducing temperature, are malleable and very ductile, whereas those prepared in oxidizing temperatures (such as cause the formation of cuprous oxide) are markedly affected by the presence of this material. OWE (2)

Magnesium and Its Alloys. (Il magnesio e le sue leghe). G. Guzzoni. *Alluminio*, Vol. 1, Jan.-Feb. 1932, pages 50-51.
Condensed from Rendic. 13ª Riun. Assoc. Ital. studi mat. costruzione, Rome, 1931. Summary of tensile properties of chill cast, sand cast and wrought Mg alloys with up to 12% Al, with some comments on Mg Zn and Mg Cu alloys. HWG (2)

Nickel and Its Non-Ferrous Alloys, with Special Reference to Welding. J. McNeil. *Welding Journal*, Vol. 29, Mar. 1932, pages 70-76; discussion, Apr. 1932, pages 106-108.
Paper read before the Institution of Welding Engineers, Jan. 1932. Deals with the physical and chemical properties of Ni and some of its representative non-ferrous alloys, methods of welding Ni and these alloys and some typical applications where welded construction has been employed. Includes general details of oxy-acetylene and metallic arc welding, such as proper flame adjustment and manipulation of the oxy-acetylene torch, composition and use of welding flux and use of coated electrodes. Physical properties of welded joints are given. TEJ (2)

Different Applications of Aluminum Bronze with a Particular Reference to Its Wear Resistance. (Applications diverses du bronze d'aluminium et notes particulières sur sa resistance a l'usure). G. H. Meigh. *Revue de Métallurgie*, Vol. 29, Apr. 1932, pages 208-214.
Al bronze is being substituted for bronze and brass in the French navy. Considerable difficulties due to segregation can be prevented by proper design of the molds and care in metallurgical treatment. Excellent physical properties and resistance to wear can be obtained. JDG (2)

Cast Alloy A. P. 33. (Alliage de Fonderie A. P. 33.) J. Suhr. *Revue de l'Aluminium*, Vol. 9, Mar.-Apr. 1932, pages 1669-1680.
This alloy is an Al with the addition of 4.5% Cu, 0.45% Ti and a minimum of Fe and Si. After heat treatment the mechanical properties are: elastic limit 22-25 kg./mm.^{2}, ultimate strength 30-35 kg./mm.^{2}, elongation 5-8%. The addition of Ti refines the grain but only up to 0.4%. Fe in small proportions does not influence strength and hardness greatly but it should not exceed 0.4% as it has a harmful influence on the properties named. The metallographic study is described in detail. Ha (2)

Silver Alloys. (Etude sur les alliages d'argent.) Leon Guillet, Alfred Petit & Jean Cournot. *Revue de Metallurgie*, Vol. 29, Mar. 1932, pages 113-132; Apr. 1932, pages 183-207.
Contemporary coinage Ag alloys besides requiring a high Ag content have a tendency to tarnish easily and sometimes involve mechanical difficulties in the manufacture. The purpose of the investigation was the development of an alloy which would be satisfactory from the following standpoints: rolling and stamping properties, color, density, stability in contact with substances to which coins are subjected in use, wear resistance and possibility of Ag recovery from the alloy. The survey of equilibrium diagrams and the published data indicated the possibilities for 8 groups of alloys: Ag-Zn, Ag-Cd, Ag-Sn, Ag-Zn-Cu, Ag-Cu-Ni, Ag-Cu-Zn-Cd and Ag-Cu-Ni-Zn. Alloys of Ag with Zn and Cd seem to be quite promising. The advantages of Zn over Cd are: whiter color with larger additions, somewhat better corrosion resistance, homogeneity of ingots, and ease of preparation. Cd makes the metal more malleable. Ag-Zn alloys can be rolled with 20% Zn but with higher amounts break in the rolls. Cd content can be raised to 40% without interfering with rolling. The microscopic study of Ag-Cd system strongly disagrees with the equilibrium diagram proposed by Guertler. Ag-Sn alloys can be made quite uniform, but the brittleness in rolling prevents their use. Cd and Zn are interchangable in the alloys so that with 10% each the alloys can be rolled but with 20% break between the rolls. A series of alloys containing 80, 60, 40% Ag, 10, 20, 45% Cu and 10, 20, 15% Ni showed that the alloys are not miscible and show pronounced segregation. Using 50% Ag, 30-25% Cu, 10-15% Zn and 10% Cd quite good physical results could be obtained but the alloy was not sufficiently corrosion resistant. Ag-Cu-Ni-Zn alloys can be made satisfactory both from mechanical and corrosion resistance standpoints provided that for 40-50% Ag at least 8-12% Ni is available together with at least 30% Cu which however must not exceed 40%. Sufficient Zn is added to make 100%. With higher Ag contents better properties will be obtained in Ag-Cu-Ni-Zn alloys having the following composition: 50-30-10-10, 68-18-6-8, 75-13-5-7. An alloy containing 39% Ag, 36% Cu, 12% Ni and 13% Zn though having a wide solidification range requiring proper means for prevention of segregations is equal or better in physical properties and corrosion resistance than the usual monetary alloy 835 Ag-165 Cu. A comprehensive study of the former is given. Best whitening is obtained with it using a 10% solution of H_2SO_4 to which either 2.5 or 5% $K_2Cr_2O_7$ is added. 10 minutes boiling is sufficient in the former and 5 in the latter. A comparison between 68% Ag-32% Cu alloy and a quarternary alloy 68% Ag-18% Cu-6% Ni-8% Zn basing on physical, metallographic and corrosion resistance study showed that the latter has a much better color and better resistance to corrosion together with the improved physical properties. Many pickling baths were studied for it. Oxidizing heating followed by HNO_3 pickling, another oxidizing heating after which H_2SO_4 pickle is used seem to be the best. The paper has 28 figures and 25 tables. JDG (2)

Lead-Nickel-Cadmium Alloys capable of being Hardened. (Aushärtbare Blei-Nickel-Cadmiumlegierungen.) B. Garre & A. Mueller. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 205, Apr. 8, 1932, page 42.
By adding up to 6% $NiCd_4$ to Pb the alloy can be hardened after annealing for a certain time. The results are shown in diagrams. Pure Pb will withstand strong H_2SO_4 better, but the alloyed Pb will behave better with dilute 10% H_2SO_4. Ha (2)

Production and Use of Light Metals and Their Alloys in Italy. (Production et application des metaux legers et de leurs alliages en Italie.) A. W. Bonaretti. *Revue de Metallurgie*, Vol. 28, May 1931, page 269.
See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 2. JDG (2)

The Change of Electrical Resistance and Hardness of a few Alloys of Lead and Thallium with Time. (Die zeitliche Aenderung des elektrischen Widerstands und der Härte von einigen Legierungen des Bleis und des Thalliums.) G. Tammann & H. Ruediger. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 192, Sept. 1930, pages 1-44.
A number of binary alloys of Pb with Cd, Bi, Sn, Na, K and Hg, and of Th with Pb, Hg and Sn were investigated with respect to the change by aging of the electric resistance and hardness. The results are given in numerous curves and numerical tables and show these properties as a function of composition, heat treatment and time. The behavior is explained by phenomena occurring in the saturated or unsaturated solid solutions according to heat treatment and composition. Ha (2)

The Effects of Cold-Rolling and of Heat-Treatment on Some Lead Alloys. H. Waterhouse & R. Willows. *Engineering*, Vol. 132, Sept. 18, 1932, pages 381-382, 387-388.
Includes discussion. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 2. LFM (2)

Corrosion-Resisting Aluminum Alloy. (Korrosionsbeständige Aluminiumlegierung.) E. Wolf. *Chemische Fabrik*, Vol. 4, Dec. 1931, page 453; *Autogene Metallbearbeitung*, Vol. 25, May 15, 1932, pages 157-158.
A new Al alloy "AW 15" of the Aluminum Works Singen is described which consists of 98% Al and 2% Mn; impurities of Fe and Si are of the same order as in pure Al. The tensile strength exceeds that of Al; it is very well suited to deep-drawing, spinning, stamping, etc. It can be soldered and welded without special fluxes. It has a great corrosion resistance and can be used for kitchen ware and in the chemical industry. Ha (2)

Rolled Rods of Aluminum. (Walzstäbe aus Aluminium.) *Aluminium*, Vol. 14, Jan. 31, 1932, pages 3-4.
Discussion of alleged American practice. Ha (2)

Aluminum and Its Alloys. L. W. Kempf. *Conference on Metals and Alloys, Case School of Applied Science*, Cleveland, Ohio, Nov. 1931, paper No. 10, 7 pages. Mimeographed.
General discussion, with special attention to heat-treatment of cast and wrought alloys. The use of Mg as alloying element in a binary Al-Mg alloy has so far met with little success but the difficulties of difficult workability in wrought alloys and of reaction with green sand in cast alloys are being overcome, so that wider use is expected. HWG (2)

Hardenable Gold Alloys. (Härtbare Goldlegierungen). *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 22, Apr. 24, 1932, page 228.
The application of hardenable Au alloys to spinning dies for the fabrication of artificial silk products is briefly mentioned. Whereas there were previously used for this purpose dies of pure Pt and alloys of Pt and Ir, there were later applied cheaper alloys of either 90% Au/10% Pt and 90% Au/10% Ir. These and similar alloys can furthermore be improved by age-hardening and then are much more resistive against mechanical strain. They are superior to other material. GN (2)

Super-Conductivity of Gold-Bismuth. (Die Supraleitfähigkeit des Gold-Wismuts.) W. J. de Haas & F. Jurriaanse. *Die Naturwissenschaften*, Vol. 19, Aug. 14, 1931, page 706.
Au-Bi alloys became supra-conductant, although the single metals do not display this property. The binary diagram of Vogel was corrected. Solution tests on the eutectic yielded crystals of Au_2Bi, which is responsible for the supra-conductivity phenomenon. The space lattice of this intermetallic compound is supposed to be tetragonal, at least different from that of Au and Bi respectively. EF (2)

The Thermal Conductivity of Some Non-Ferrous Alloys. D. Hanson & C. E. Rodgers. *Institute of Metals, Advance Copy* No. 593, Apr. 1932, 6 pages.
Thermal conductivity measurements were made by the "guard-tube" method. Results are given for a series of Cu-Al alloys, both Cu-rich and Al-rich. The effects of small amounts of Fe, Ni, As and P on the thermal conductivity of Cu are also shown. JLG (2)

Non-Ferrous Metals. I. Light Metals. (Nichteisenmetalle. I. Leichtmetalle.) H. Christen. *Schweizerische Technische Zeitschrift*, Vol. 29, Mar. 17, 1932, pages 153-159.
The article gives a detailed survey of composition and properties of light metal alloys with special reference to those of the Al-Mg type. These metals are considered in 2 groups, cast alloys and malleable alloys. Among the first group there are dealt with (1) Alufont, produced by the Aluminium Industrie A.G., Neuhausen, Switzerland, (2), the American alloy No. 12, (3) Silumin, (4) K.S. Seawater, (5) Anticorodal, an alloy made by the Aluminium Industrie A.G., with a particularly high resistance to corrosion. Among the malleable alloys discussed are: (1) Duralumin, (2) Avional, made by the A.I.A.G., the composition of which corresponds about to that of Duralumin, (3) Anticorodal, (4) Aldrey which is successfully used for transmission of electric current, (5) Electron with about 90% Mg contains Zn, Mn, Al, Si, Cu and Cd. The paper is supplemented by a review of the literature and contains 7 references. GN (2)

The Compressive Strength of Duralumin Columns of Equal Angle Section. E. E. Lundquist. *Technical Notes, National Advisory Committee for Aeronautics*, No. 413, Mar. 1932, 12 pages. Mimeographed.
Duralumin angles of equal leg widths, in different widths (1¼" to ½") and thicknesses (0.4" to 0.125") and in different lengths were tested in compression, noting whether failure was by twisting, bending, wrinkling, etc. The data are collected into column charts showing stress for failure vs. different 1/r ratios, for coefficients of end fixity equalling 1 and 2. HWG (2)

Nickel-Copper Alloys of High Elastic Limit. D. G. Jones, L. B. Pfeil & W. T. Griffiths. *Engineering*, Vol. 132, Sept. 18, 1931, page 382.
See *Metals & Alloys*, Vol. 2, Dec. 1931, page 297. LFM (2)

Cemented Tantalum Carbide Tools. Floyd C. Kelley. *Transactions American Society for Steel Treating*, Vol. 19, Jan. 1932, pages 233-246.
Includes discussion. See *Metals & Alloys*, Vol. 3, June 1932, page MA 159. WLC (2)

PROPERTIES OF FERROUS ALLOYS (3)

Effect of Machining on Transverse Test Results of Cast Iron. (Einfluss der Bearbeitung auf die Ergebnisse des Biegeversuchs bei Gusseisen.) GUSTAV MEYERSBERG. *Archiv für das Eisenhüttenwesen,* Vol. 5, Apr. 1932, pages 511-512.

Deflection, modulus of rupture, and strain number were determined on 592 test rods of various brands of cast Fe. For the transverse tests, bars 650 mm. long, width between supports 600 mm., were divided into 3 groups: Group I—ordinary rough rods, 30 mm. diam.; Group II—half machined rods, cast 34 mm. diam. and machined to 30 mm. diam. over 200 mm. length equidistant from ends of rods. Group III—completely machined rods; cast 34 mm. diam. and turned to 30 mm. diam. over entire length of rod. Comparison of average values shows that a slight increase of deflection (f) and modulus of rupture (σ_B) for Group II rods as against Group I. The strain number (Z_f) remains practically constant. Group III rods show further increases only for (f) and Z_f scarcely any increase for σ_B. The deviations in test results, computed graphically, showed somewhat less values for completely turned rods than for rough cast samples, an indication that the release of casting stresses is the characteristic difference which chiefly distinguishes machined rods from unworked material.

Cast Iron Brand	f-Deflection mm.			Modulus of Rupture σ_B Kg./mm.^{2}			Strain Number, Z_f $\frac{mm.^3}{Kg.} \times 100$		
	I	II	III	I	II	III	I	II	III
1	12.33	12.32	13.35	42.75	43.26	43.49	28.98	28.50	30.73
2	9.66	10.25	....	40.74	43.79	....	23.19	23.54	....
3	11.60	12.36	....	45.13	48.36	....	25.13	25.54	....
4	11.43	11.98	....	41.81	42.89	....	28.12	27.54	....
5	11.55	11.85	....	45.73	47.82	....	25.23	24.94	....
6	11.48	12.23	13.38	50.61	54.66	55.63	22.83	22.49	23.88

DTR (3)

Physical Properties of Steel After Plastic and Yield-Point Extension. J. MUIR. *Journal Royal Technical College* (Glasgow), Vol. 2, Jan. 1932, pages 571-586.

The great difference between the elastic properties of steel stretched by successive yield-points or by single loading to the same amount is dealt with. By "yield-points" the author apparently refers to a definite elongation (2%). Experiments on wires and rods are described, and a brief review of the single crystal experiments of Joffé and of the elastic hysteresis theory of Prandtl is given. Yield-point extension is likened to a shift such as twinning in a single crystal, and plastic extension to gliding. The outstanding differences in elastic properties suggested a search for other manifestations of change of state, and experimental work undertaken at different times on slip-bands, density, electric resistance, magnetic and thermoelectric properties are brought together and briefly described. It is shown that whereas steel stretched (1) by yield-points (2) to the same extent by a single loading, possesses very different elastic properties, it does not appear to differ appreciably in any other property. WAT (3)

Austenitic Cast Iron. J. E. HURST. *Machinery, London,* Vol. 39, Feb. 4, 1932, pages 586-587.

See *Metals & Alloys,* Vol. 3, July 1932, page MA 197. (3)

Aging Notch Toughness and Force Influence Figure Etching. (Alterungskerbzähigkeit und Kraftwirkungsfiguren-Aetzung). F. NEHL. *Archiv für Eisenhüttenwesen,* Vol. 5, Apr. 1932, pages 535-536.

Includes discussion. After review of literature on aging of boiler tubes, the author found that notch strength after aging for Izett steel tubes and ordinary open hearth steel tubes were alike. A special notch impact test-piece was designed for examining boiler tubes, in addition to the usual test size of 15 × 30 × 160 mm., with impact cross-section 15 × 15 mm. In normalized condition the test pieces showed an average notch strength of 18.3 mkg./cm.^{2}, while in artificially aged state 2.5 mkg./cm.^{2}, a pronounced difference. Total of 1,000 hydrogen-welded high safety factor boiler drums produced from 1924 to 1931 showed no defects due to aging or fatigue causes either in drums or in boiler tube systems. In discussion H. Jungbluth started with sheets 20 mm. thick and drawn to 5 or 7 mm.

Material	Thickness	Composition % C	% Si	% Mn	% P	% S
A	5	0.09	0.01	0.47	0.016	0.019
J	7	0.12	0.05	0.46	0.016	0.024

Notch strength—temperature curves in annealed and aged materials are given. Difference between aging resistant and non-resistant material lies in amount of cold roll reduction. DTR(3)

Izett Steel. G. G. NEUENDORFF. *Metals & Alloys,* Vol. 3, Mar. 1932, pages 61 68.

14 references. The author describes the superior toughness of "Izett" steel to common boiler plate. It is not markedly affected by aging after cold work with resultant embrittlement. A large amount of data is given on notched bar tests of both steels. This new German steel seems to owe its properties to special methods of melting and working and to the skill of the metallurgical supervision of these operations. Information is given and applications discussed where Izett is welded and riveted into various types of boiler or pressure containers. WLC (3)

The Wear and Surface Condition of Cast Iron. *Metallurgist,* Sept. 1931, pages 132-134.

An extended abstract of papers by Th. Klingenstein and by W. Schilken in the Apr. 1931 issue of *Mitteilungen Forschungsanstalten G. H. H. Konzern.* See *Metals & Alloys,* Vol. 2, Aug. 1931, page 154. VVK (3)

The Phenomenon of Tensile Yield in Mild Steel and Iron. J. G. DOCHERTY & F. W. THORNE. *Engineering,* Vol. 132, Sept. 4, 1931, pages 295-297.

Contribution to the Report of the Committee on Stresses in Overstrained Materials presented to Section G. of the British Association for the Advancement of Science, Sept. 30, 1931. LFM (3)

"Migra-Iron," a New Special Pig Iron for High Quality Casting. (Ueber "Migra-Eisen," ein neues Specialroheisen für hochwertigen Guss.) E. PIWOWARSKY. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 2 pages.

See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 3. (3)

The Growth of Cast Iron Under Tension Stress. (Das Wachsen von Gusseisen unter Zugbeanspruchung.) E. PIWOWARSKY & BORNHOFEN. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 4 pages.

See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 31. (3)

Brinell Hardness and Tensile Strength of Cast Iron. J. G. PEARCE. *Bulletin British Cast Iron Research Association,* Vol. 3, Apr. 1932, page 85.

A series of tests was made to find a possible way to express tensile strength in terms of Brinell hardness. The formula: $\text{Tensile Strength} = \frac{\text{Brinell Hardness}}{8} - a$ where a is a constant found in the tests as varying between 11.5 and 17.5, gave however too unreliable results to be of any practical value for the adoption for specifications. No relation was found between hardness and machinability or hardness and abrasive wear. Ha (3)

The Effect of Superheating and Casting Temperature on Common Commercial and Machinery Cast Iron. (Der Einfluss der Ueberhitzung und der Vergiesstemperatur auf gewöhnlichen Handels- und Maschinenguss.) H. PINSL. *Zeitschrift für gesamte Giessereipraxis,* Vol. 53, Apr. 17, 1932, pages 153-156.

The paper first refers to the German investigations on the effect of superheating on the properties of cast iron and then deals with the experiences of a German cast iron foundry in superheating. The results of superheating on the mechanical properties of cast iron to be used for tubes and made in a reverberatory furnace as well as the effect of the casting temperature on hardness and impact hardness of cast iron to be used for brakes are shown in diagrams. GN (3)

The Curie Point in Ferro-Cerium (Point de Curie du ferro-cérium). G. RASSAT. *Comptes Rendus,* Vol. 194, Apr. 4, 1932, page 1153.

The author has observed that samples of ferro-cerium containing approximately 27.5% Fe lose their magnetism in the neighborhood of 40° C. In the case of ferro-cerium containing 32% Fe, the phenomenon is less distinct. At 40° C. there is a definite diminution in attraction, but magnetism does not disappear completely, persisting up to the temperature of combustion of ferro-cerium. The author suggests that the loss of magnetism of these alloys might be put to use in connection with apparatus for the control of temperature, etc. OWE (33)

The Relation between the Effective Flowing Stress and Hardness. (Ueber die Beziehung zwischen effektiver Fliessspannung und Härte.) F. SAUERWALD & F. RAKOSKI. *Zeitschrift für Metallkunde,* Vol. 24, Apr. 1932, pages 95-96.

Tensile bars of mild steel were stressed to values between the yield point and the tensile strength, and then removed and their hardness measured ("fall-hardness"). It was found that a simple proportionality existed between degree of stressing and the hardness. RFM (3)

Magnetic and Mechanical Hardness of Dispersion Hardened Iron Alloys. K. S. SELJESATER & B. A. ROGERS. *Transactions American Society for Steel Treating,* Vol. 19, Apr. 1932, pages 553-576.

Includes discussion and 12 references. The authors describe the magnetic and mechanical properties of certain carbonless Fe alloys with W, Mo, Be and Ti. Ternary alloys where the base of the alloy was Fe 65%, Co 35% instead of pure Fe were also studied. Graphs show the change of mechanical hardness with aging temperature as well as the magnetic properties. In discussion the authors suggest a relation between the effective percentage of the precipitating element and the molecular weight of the compound precipitated. Binary alloys of Fe-W are shown to have the properties of good permanent magnets. Fe-Mo alloy exhibits the highest coercive force, Be alloys attain the highest mechanical hardness and Ti alloys exhibit maximum mechanical and magnetic hardness at quite different aging temperatures. In the ternary Fe-Co-W the same feature of minimum coercive force at maximum mechanical hardness as was found in Fe-Ti alloys is displayed and the maximum coercive force is obtained at somewhat higher aging temperature. Where high hardness is obtainable by aging the possibility of these alloys for tools is suggested. WLC (3)

Electric Cast Iron. (Elektro-Gusseisen.) W. HEIMANN. *Maschinenkonstrukteur-Betriebstechnik,* Vol. 64, Aug. 10, 1931, pages 175-176.

The quality of cast Fe should be improved, and the loading capacity increased. Quality can be obtained by electric furnace melting. A typical induction furnace is described. Good melting means good properties, high tensile strength, and good machinability. The composition and temperature of the Fe in the bath should be carefully regulated. A cast Fe with (the usual) 3% C alloyed with Si, Mn, P, and S will have varied properties. It is affected as steel is by Cr, Cu and Ni. The C content can be regulated in the electric furnace to an accuracy of 0.1%. Si (1.5-2.5%) improves the machinability of gray castings by formation of graphite. Si and Mn content may be regulated to an accuracy of 0.1-0.2% in the electrical furnace. The structure of the casting with respect to the graphite is of prime importance. A pearlitic matrix in a 3% C Fe should have 0.9% combined C (carbide) with the remaining C as graphite. If the graphite is below 2%, the Fe becomes hard and brittle. MAB (3)

Industrial Steels and Alloys. J. W. DONALDSON. *Heat Treating & Forging,* Vol. 18, Feb. 1932, pages 107-109; Apr. 1932, pages 242-244.

Condensed from *Chemistry & Industry,* Vol. 50, Sept. 25, 1931, pages 787-793. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 3. MS (3)

Overheating and Burning of Mild Steel. *Metallurgist,* Oct. 1931, pages 148-149.

A review of a paper by Pohl, Krieger & Sauerwald. See "Investigation of the Heat Sensibility of Low Carbon Steel," *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 31. VVK (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS AND ALLOYS (4)

The Poisoning of Reactions in Heterogenous Systems. (Die Vergiftung der Reaktionen in heterogenen Systemen.) K. Jablczynski & J. Maczkowska. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 197, Apr. 30, 1931, pages 292-300.

Additions of very dilute solutions of H_2S, KCN, and As_2O_3 act as poison to the dissolution of Mg in 0.1 *N* HCl. The dissolving velocity of technical Zn in 0.1 *N* HCl is greatly reduced by KCN; As_2O_3, H_2S and iodine have an activating effect. The latter additions increase the dissolving velocity 77, 30 and 17% respectively. Ha (4)

The Significance of the Hydrogen Absorption of Iron During the Corrosion Process. (Die Bedeutung der Wasserstoffaufnahme des Eisens für den Korrosionsvorgang.) E. Liebreich. *Korrosion und Metallschutz*, Vol. 8, Jan. 1932, pages 1-4.

The hydrogen originated at the surface of iron is (a) partly transferred into water due to the oxygen in solution, (b) partly diffused into the solution if oxygen is absent, and (c) partly occluded at the iron surface and later migrating along the grain boundaries into the interior regions. The last phenomenon, largely dealt with in the paper, is proved according to Förster by the electrochemical potential which, in contrast to Al or Mg, is shifted to negative values. The writer furnished a new proof by studying the cathodic over-voltage of steel wires which were employed in a fresh state and after a 24 hours exposure to the corrosive attack of a KCl solution. The cathodic over-voltage phenomenon, which has not always been duly recognized, is complicated by the uneven absorption and occlusion of hydrogen resulting in the formation of local elements. The accelerated corrosion rate at spots in contact with foreign matter has not been fully explained yet. The interpretation of Evans based on differential aeration is rejected by the writer on account of his fundamental "drop (suspended) test" and "plate test" (partly submerged). In addition to the effect of occluded hydrogen which renders the potential less noble, an acceleration of the corrosion attack is caused by the bi-valent corrosion products. The writer assumes that the "physical depolarization," i. e. the diffusion of hydrogen into the solution is retarded or even completely suppressed by the viscous hydroxide layer formed at the iron surface. Consequently the hydrogen liberated exerts a higher pressure resulting in an increased migration into the interior parts of the metal. This merely mechanical procedure can be proved if the gas is not allowed to escape, accomplished by partly covering the surface of the iron with dustlike glass powder and then exposing the metal to the attack of an electrolyte in a hydrogen atmosphere. Those spots covered by foreign matter are pitted more effectively. The prevention of the mechanical depolarization is responsible for many corrosion attacks in daily life and industry. However, the corrosion due to the differential aeration of a metal surface may principally occur. 14 references. EF (4)

Corrosion as a Physico-Chemical Problem. (Die Korrosion als physikalisch-chemisches Problem.) H. Mark. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and the Verein deutscher Chemiker*, Oct. 20, 1931, Berlin.

The investigations on catalysis on the one hand and on the corrosion of metals on the other hand indicate that they both have many similar aspects. In both cases, it is a study of occurrences on surfaces which are effected by the area of the surface and its activity. In order to determine these 2 factors independently one of the other, it is necessary to study the dependence of the occurrences upon the temperature. This has repeatedly been done for the catalysis. The present status of catalysis is reviewed and its relations to the problems of corrosion are discussed. GN (4)

From Empirical to Fundamental Facts of Corrosion. (Vom Empirischen zum Grundsätzlichen im Einzelfalle der Korrosion.) G. Masing. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and the Verein deutscher Chemiker*, Oct. 20, 1931, Berlin.

In the cases of Fe, Cu, Al and Ni, the author shows that it is possible to arrive at definite conclusions as to their corrosion behavior in considering the elementary electro-chemical principles of corrosion. Cu is distinguished by a rather noble potential (+0.34) and, therefore, does not develop H in acids. Cu_2O does not adhere to the metal and does not offer protection. Cu therefore easily oxidizes and is rather insensible towards acids. In comparison with Cu, Al is not noble but owes its technical application to the adherence of its oxide to the metal. The difference in the potential of Fe'' and Fe''' offers various possibilities of increasing the corrosion resistance of Fe. This can be done either by favoring the oxidation and accelerating the formation of Fe''' and thus making Fe passive or by decreasing the solubility of FeO, for instance in alkalic solutions, or by alloying it with metals which form insoluble oxides, as for instance Cr. The potential of Ni (—0.25 Volt) is between that of Cu and Fe. It results that Ni is not stable against the attack of strong acids but practically stable against weak acids. In neutral electrolytes Ni stands up much better than Fe probably because the NiO formed is much less soluble than FeO. GN (4)

Combating Corrosion in the Textile Industry. R. Cottrell. *Textile World*, Vol. 79, May 2, 1931, pages 70-73.

Corrosion difficulties encountered in the textile industry and the damages done by them are discussed. Data pertaining to the action of various chemicals on the materials used for textile equipment are tabulated and suggestions made for the proper selection of appropriate materials for equipment. Advantages in the use of Monel metal and other Ni-bearing alloys are pointed out. Ha (4)

Corrosion of Aluminum Alloys in Superheated Steam. (La Corrosion des Alliages d'Aluminium dans la Vapeur d'eau surchauffee.) Leon Guillett & M. Ballay. *Aciers Speciaux, Metaux et Alliages*, Vol. 6, July 1931, page 361.

See *Metals & Alloys*, Vol. 1, Dec. 1930, page 904. GTM (4)

Metals That Resist Alkali Corrosion. John L. Everhart. *Chemical & Metallurgical Engineering*, Vol. 39, Feb. 1932, page 88.

General corrosion data are given for 10 metals tested in mixed alkali liquors. Ni and Ni rich alloys resist caustic soda liquors, though cast iron is usable because of low cost. Cast iron and cast steel resist sodium carbonate liquors. Ni-Cr-Mo (35-25-5) alloy is resistant to ammonium chloride liquors. Cast iron and 18-8 resist sodium chloride-ammonium hydroxide mixtures. Monel metal shows excellent resistance to calcium chloride liquor. PRK (4)

Safe-Guarding Cracking Operations from Accident. E. M. Matson. *Refiner & Natural Gasoline Manufacturer*, Vol. 10, May 1931, pages 99-101; June 1931, pages 110, 112.

The paper deals with corrosion of cracking equipment. WHB (4)

The Use of Neutralizers for Inhibiting Corrosion of Refinery Equipment. L. G. Metcalf. (Union Oil Co. of Calif.) *Proceedings American Petroleum Institute*, Dec. 1931, Section IV, pages 110-121.

This is the report of the Sub-Committee on Neutralizers appointed in Nov. 1930 and consists of information derived from a questionnaire to 27 refiners, 17 of whom replied. Corrosion of refinery equipment is broadly classified as (1) low-temperature corrosion in the presence of water and (2) high-temperature corrosion. Low-temperature corrosion in the presence of water is encountered in most distillation equipment in the cooling and condensing systems where the temperature and pressure conditions are such that water can be condensed. The factors influencing such corrosion are the acidity or alkalinity of the corroding water solution, the presence of dissimilar metals, and turbulence. The corrosive agents are (1) HCl formed by the hydrolysis of Mg and calcium chlorides accompanying a wet crude oil, (2) H_2S, (3) CO_2, a negligible factor when compared with HCl and H_2S, (4) dissolved O which is also a negligible factor on the oil side of condensing equipment and (5) organic acids which are important in California crudes where the acid number may be as high as 2 or 3 but not with Eastern or Mid-Continent crudes. The neutralizers in use for low-temperature corrosion are (1) ammonia, which is used either in liquid or vapor form, (2) caustic soda, which is used especially for neutralizing H_2S for which purpose ammonia cannot be used, and (3) soda ash which has no advantage over the other neutralizers save that of lessened cost. The most important factors influencing high-temperature corrosion are temperature and turbulence. The corrosive agents in this type of corrosion are free sulphur and sulphur compounds, naphthenic acids and inorganic acids such as HCl and sulphurous acid when accompanied by water or an aqueous film. The neutralizers used for high-temperature corrosion are lime, caustic soda and ammonia. The detailed experience of the various refiners in the use of neutralizers is given. The question of cost is also considered with the conclusion that for inhibiting low-temperature corrosion, neutralizers may show a real saving but for inhibiting high-temperature corrosion careful attention is necessary to insure against excessive costs and inadequate returns. VVK (4)

Opening Remarks to the Group Session on Corrosion of Oil Field Equipment. C. R. Weidner. (Prairie Pipe Line Co.) *Proceedings American Petroleum Institute*, Dec. 1931, Section IV, page 26.

Introduction to the Group Session on Corrosion of Oil Field Equipment by the Chairman of the Committee on Corrosion of Oil Field Equipment. Progress in combating corrosion in the oil industry has consisted in (1) the preparation and distribution of a code of good practice in the application of protective coatings, (2) the recognition of corrosion mitigation as an economic problem, (3) the identification of inadequate and uneconomic coatings on existing pipe lines, (4) the determination of some of the causes of coating failures such as soil stress and mechanical distortion, (5) progress in determining the corrosivity of soils, (6) the stimulation of interest in the corrosion problem by the publicity given to it by the committee. It is estimated that over a million dollars has been saved in the oil industry in the past few years by the work of the Committee and the Bureau of Standards. VVK (4)

Treat Refinery Gases to Reduce Corrosion of Gasoline Recovery Plant Equipment. W. T. Ziegenhain. *Oil & Gas Journal*, Vol. 30, Feb. 4, 1932, pages 10-11.

To minimize corrosion in the vapor recovery system at the Gulf Refining Co.'s plant at Port Arthur, Texas, two Koppers treating plants for the removal of H_2S from the gas have been installed. 9,000,000 ft.^{3} of gas per day from crude stills, coking stills and various pressure cracking units handling high S oils is treated, the H_2S removal ranging from 88 to 98%. This process is the Seaboard liquid purification process and was described in detail by D. J. Jacobson in the *Oil & Gas Journal*, Apr. 4, 1929, page 116. VVK (4)

Operating a High-Pressure Boiler Plant. (Aus dem Betrieb eines Hockdruckdampf-Kesselhauses.) *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Dec. 1931, pages 357-358.

Discusses the difficulties encountered by flaking (rust) and scaling in the operation of a boiler plant. The different detrimental effects of coal dust and ashes are considered as well as that of H_2SO_4 which is present in the waste gases. Ways of removing the acid are given. MAB (4)

Corrosion From Flue Gases. *World Power*, Vol. 27, Feb. 1932, page 122.

Every industrial fuel contains some S and H, with the result that S and moisture inevitably occur in flue gases. When gases are reduced to the dew point of the vapor, combination of the S (whether existing as SO_2 or SO_3) will occur, forming an acid solution which acts corrosively. Such corrosion frequently occurs at economiser headers, in air heaters and the surfaces of steel flues, even when the exit gas temperatures are well above the dew point. To avoid such corrosion, therefore, it is necessary to heat the feed-water to at least 100° F., preferably 120° F., with cast Fe economisers, and with steel 130°-140° F. The increased temperature of the feedwater, naturally, involves some decrease in the efficiency of the heat exchange. This, however, is less serious than occurrence of corrosion. (4)

The Action of Alkalies and Salts upon Mild Steel under High Pressure Conditions and the Protective Action of Sodium Sulphate Against Attack. (Ueber die Einwirkung von Laugen und Salzen auf Flusseisen unter Hockdruckbedingungen und über die Schutzwirkung von Natriumsulfat gegen den Angriff von Aetznatron und von Chlormagnesium.) E. Berl & F. van Taack. No. 330 of the series "Forschungsarbeiten auf dem Gebiete des Ingenieurwesens" published by VDI-Verlag G.m.b.H. 1930, 32 pages, 34 figures & 33 tables, price 5 RM.

This contribution continues the earlier research work carried out by the Feed Water Committee of the Verein Deutscher Ingenieure upon the corrosion of steam boilers. The intercrystalline attack of caustic soda on boiler metal at riveted seams had been recognized. In this research, corrosion tests have been extended to include a very great number of salts. Mild steel was enclosed in a bomb capable of withstanding a pressure of more than 250 atmospheres and exposed to the same conditions as in the actual operation of high-pressure steam boilers. It was found that sodium sulphate not only prevents embrittlement but also prevents purely chemical corrosion up to a concentration of 50 g./l. of caustic soda. Nitrates and phosphates exert a similar action while chromates have the effect of increasing the attack when in alkaline solution. Sodium sulphate also represses the action of magnesium chloride or HCl at high temperature. The explanation of the protective action is to be found in the fact that sodium sulphate promotes the formation of a protective layer of oxide on the Fe. The nature of the oxide is investigated by X-ray analysis. Coatings of Ni and Cr were investigated, both proving effective against caustic soda. However the Ni layer was dissolved by magnesium chloride which, on the other hand did not affect the Cr layer provided it was sufficiently thick. A wealth of data is given on the effect of various salt solutions on iron. VVK (4)

Occurrences of Corrosion in High-Pressure Steam Boilers. (Korrosionserscheinungen in Hochleistungsdampfkesseln.) F. Lupberger. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and the Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

The paper gives a survey on the occurrences of corrosion in high-pressure steam boilers: corrosion through chemically pure water or through salts dissolved in it, corrosion through the chemical reaction between iron and either water or steam, and corrosion through waste gases. The remedies are discussed. GN (4)

Caustic Embrittlement of Steel. (Über die "Laugenbrüchigkeit" des Stahles.) F. Hundeshagen. *Chemiker-Zeitung,* Vol. 56, Jan. 2, 1932, pages 4-5; Jan. 6, 1932, pages 17-18; Jan. 13, 1932, pages 39-40.

The literature on caustic embrittlement is reviewed and 33 references are given. Embrittlement of steel in boilers occurs at points of highest stress, around bolt and rivet holes, along seams and on rivets. It occurs oftener in high pressure boilers. At these points the tensile, transverse and especially the impact strength is reduced. Microscopic examination shows intercrystalline cracks without plastic flow. According to the *American* theory embrittlement is caused mainly by NaOH which is formed in the boiler from Na_2CO_3 present in the water or added as softening treatment. At the water line, at seams and in crevices NaOH reaches higher concentrations due to evaporation of water and attacks the intercrystalline cement and the impurities in the steel which segregate at the grain boundaries. Conditions considered necessary for caustic embrittlement to take place are high mechanical stress in the steel, above the yield point, the NaOH concentration of at least 300 g./l. NaOH is considered the only chemical which causes embrittlement. Sulphates in sufficient quantity act as a preventive and sulphates are purposely added to boiler water as a protection. In contrast to this the *German* theory claims that embrittlement is not due to caustic alkali, that it takes place at times in the complete absence of NaOH, and that fractures sometimes occur above the water line. Instead it is due to over-straining and overheating of the steel and to improper design and operation of the boilers. Sulphates do not prevent embrittlement. Nitrates and Ca $(OH)_2$ aid, $CaCl_2$ and Na_2CO_3 retard embrittlement. To prevent embrittlement a good quality of steel should be used and the boilers should be properly constructed and operated under correct working conditions. Chromates added to the water break down at higher temperatures but phosphates are beneficial. CEM (4)

Caustic Embrittlement in Boilers. H. E. Wallsom. *Fuel Economist,* Vol. 7, Feb. 1932, pages 163-166.

A number of good points are brought out. (1) Steel in contact with caustic soda in solution suffers corrosion by embrittlement. (2) For such embrittlement to occur, it is essential that the steel should previously have been stressed —a condition which is very usual in boiler construction. (3) Caustic embrittlement may be prevented or inhibited by a maintenance in the water in contact with the steel, of a definite concentration of Na_2SO_4 in relation to concentration of NaOH. This ratio varies with pressure and temperature at which the action takes place. It is preferable that other compounds, such as Na_3PO_4, should be used together with Na_2SO_4, to act, in addition to inhibitors, as precipitating reagents for harmful compounds likely to be formed by introduction of Na_2SO_4. DTR (4)

Alloys of Iron with Aluminium. *Metallurgist,* Apr. 1931, pages 62-63.

An extended abstract of a paper by A. Hauttmann in *Stahl und Eisen,* Vol. 51, Jan. 15, 1931, pages 65-67. See "Heat Resistivity of Aluminum Steels, and Aluminum Coated Iron," *Metals & Alloys,* Vol. 2, Sept. 1931, page 165. VVK (4)

Corrosion of Aluminum by Ammoniacal Solutions. (Sur l'Attaque de l'Aluminium par les Solutions Ammoniacals.) J. Calvet. *Aciers Speciaux, Metaux et Alliages,* Vol. 6, July 1931, pages 360-361.

See *Metals & Alloys,* Vol. 1, Dec. 1930, page 904. GTM (4)

The Anodic Treatment of Aluminium. Edwin Joyce. *Brass World,* Vol. 28, Feb. 1932, pages 29-32.

A protective oxide coating is formed by electrolysis. The Al or Al-alloy is connected to the positive terminal of the generator and electrolysis is conducted in a 3-10% Cr_2O_3 solution. Oxygen liberated at the cathode produces the oxide coating. The process is detailed and the nature of the coating and the cost of operation discussed. Discussion brought out that the presence of a small amount of CrO_3 in the coating is advantageous, while with the H_2SO_4 process retained acid counteracts the corrosion resisting properties of the oxide-coated Al. WHB (4)

Protection of Light Alloys Against Corrosion. (La Protection des Alliages Légers Contre la Corrosion.) M. Pubellier. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Nov. 1931, pages 575-585.

The most important part of this article, which is only a review of the subject as is found in literature, is the aging tests made by a Swiss company on soft metals. These tests revealed the fact that in natural aging the difference of electrical potential remained always positive whereas in artificial aging at 150° C. this potential dropped to the negative side after 6 hours and continued to decrease with the duration of aging at 150° C. GTM (4)

Protection of Aluminum by Anodic Treatment. Joseph Rossman. *Metal Industry,* N. Y., Vol. 30, Feb. 1932, pages 51-52; Mar. 1932, pages 108-110.

Methods, as disclosed in the patent literature, are described for anodically treating Al. PRK (4)

Corrosion of Duralumin Rivets. J. E. Sullivan. *Aviation,* Vol. 30, June 1931, pages 347-349.

The frequently experienced severe corrosion of duralumin rivets in sea water can be traced to wrong heat treatment of the rivets. It is recommended that the rivets should be heated for at least 20 min. to 510° C., quenched in plenty of cold water and used within 30 minutes. Storing the rivets at 0° C. prevents hardening so that they keep in good condition for use for 24 hours. Ha (4)

The Behavior of Aluminum and Aluminum Alloys in Hydrogen Peroxide Solutions. (Das Verhalten von Aluminium und Aluminiumlegierungen in Wasserstoffsuperoxydlösungen.) W. Wiederholt. *Korrosion und Metallschutz,* Vol. 8, Jan. 1932, pages 4-15.

14 references. Presents the results of tests on a large scale on 3 grades of pure Al containing 98/99%, 99% and 99.5% Al and on 8 different Al alloys containing various amounts of Zn, Cu, Mn, Si, Mg, Sb and alkalies. The samples were tested in H_2O_2 solutions of the following concentrations: 60, 50, 45, 40, 30, 15, 9, 5, 0.9, 0.5 and 0.05% by weight. Some sets of experiments were carried out in the absence of day light. The results may be summarized as follows: Low additions of H_2O_2 (up to about 1%) intensify the formation of a protective film on pure Al recognized by a more pronounced discoloration. H_2O_2 is decomposed by Al. Oxygen bubbles occur which stick tightly to the surface of the metal. Underneath these spots no protective layer is formed but corrosion takes place accompanied by the precipitation of Al hydroxide. The extent of the corrosion attack depends directly on the number of the occurring gas bubbles which however appear quite irregular. Higher H_2O_2 concentrations increase the acidity of the solution, the corrosion products being precipitated in a soluble form. A general attack of the entire surface can be noticed. The corrosion rate, however, is very low. The largest corrosion speed observed amounted to 200 years for a 1 mm. sheet. Besides its concentration, the amount of liquid per 1 cm^2 metallic surface proved to be of importance. Using 1 cc. solution (5 and 9% H_2O_2) on 1 cm^2 surface, the solution product of $Al(OH)_3$ is exceeded, a flocculent precipitate occurs and the enrichment of the corrosion products led to local disturbances of the corrosion attack. The acidulous character of the solutions shows up to 30% H_2O_2. Between 40 and 60%, the oxidizing effect of the reagent predominates and the corrosion products are immediately oxidized and deposited in a tightly adherent form somewhat similar to the anodic oxidation phenomenon. The different behavior of Al submitted to the attack of H_2O_2 solutions of various concentrations is due to the different kinds of deposition and formation. The effect of H_2O_2 solutions exerted on the various Al alloys is analogous to pure Al in regard to the kind and magnitude of the corrosion attack. Sodium silicate additions cut down the attack in solutions of low concentrations. The protective layers formed by H_2O_2 solutions withstood favorably the attack of a 10% HCl and *N* NaOH solution. EF (4)

The Influence of Variations in Heat Treatment and Aging on Duralumin. Zeerleder. *Engineer,* Vol. 152, Oct. 2, 1931, page 358.

Abstract of a paper read before the Institute of Metals, Zurich, Switzerland, Sept. 15, 1931. See *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 57. LFM (4)

Resistance of Iron-aluminum Alloys to Oxidation at High Temperatures. N. A. Ziegler (Westinghouse Electric & Mfg. Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 450, Feb. 1932, 6 pages.

Vacuum melted alloys containing as much as 7.95 Al and from practically nil to 0.4% C were used. Small discs of the forged materials were heated for 2 hr. intervals from 600 to 1100° C. (at 100° intervals) in an oxidizing atmosphere. The samples were weighed before heat treatment, the scale ground off after treatment, and the oxidation estimated from the change in weight. Even 2% Al greatly increased the resistance to oxidation. The highest Al alloys were the most resistant, but the 6% Al alloys were almost as good. The 6% Al alloys were only slightly inferior to an 80-20 Ni-Cr alloy. The C content had little effect on the oxidation. JLG (4)

Reduction Potential of Quadrivalent to Trivalent Iridium in Hydrochloric Acid Solutions. Sho-Chow Woo. *Journal American Chemical Society,* Vol. 53, Feb. 1931, pages 469-472.

Results of electromotive force measurements and the free energy decrease and heat content decrease of the reduction of quadrivalent to trivalent iridium ion are given. MEH(4)

Copper in the Manufacture of Condenser Tubes of Steam Turbines. (Le Cuivre dans la Fabrication des Tubes de Condenseurs de Turbines á Vapeur.) *Cuivre et Laiton*, Vol. 5, Feb. 15, 1932, pages 53-60.

The article gives a general review of the characteristics of condenser tubes, their maintenance and manufacture. The most generally used materials are: Muntz metal, 60% Cu, 40% Zn; Brass, 70% Cu, 30% Zn; Admiralty Brass, 70% Cu, 29% Zn, 1% Sn; Cupro-nickels, now mostly 70% Cu and 30% Ni, which have a better resistance to sea water than the before mentioned materials; Ambrac, 75% Cu, 20% Ni, 5% Zn, or 65% Cu, 30% Ni and 5% Zn; Alumbro, 76% Cu, 22% Zn, 2% Al. The corrosion resisting property of the latter material is particularly great because of the thin oxide film which forms and protects against progressing corrosion. The cleaning of condenser tubes and apparatus for this purpose is also treated. The causes of corrosion can be due to the tubes themselves if the composition is not suitable for the particular case, or external influences, such as chemical action by seawater, or vibrations or stray currents by the formation of galvanic elements. Means for eliminating the latter are described. A list of bibliographical references on general matters and on corrosion is added. Ha (4)

Determination of the Solution Speed of the Different Crystal Faces of Copper Single Crystals. (Bestimmung der Lösungsgeschwindigkeit der verschiedenen Flächen von Kupfereinkristallen.) R. Glauner & R. Glocker (Technische Hochschule Stuttgart) *Zeitschrift für Kristallographie*, Vol. 80, Nov. 1931, pages 377-390.

A method is developed for measuring the solution speeds of any number of crystal faces of different orientation by determining the losses in weight. The solution velocities of 7 crystal faces of Cu single crystals are determined in organic and inorganic media. For a special case, i.e., acetic acid + hydrogen peroxide, the anisotropic behavior of the solution speed is presented by a space model. In many testing solutions the (100) plane showed the lowest solubility, however, a reversion of succession can take place. It is noted that organic acids of the same homological series acted differently in regard to the occurrence of the maximum and minimum of solubility. The influence of contaminations on the solution speed is discussed and proved to depend essentially on the solution media, which are correspondingly subdivided into 2 groups. EF (4)

Corrosion of Copper. (La Corrosion du Cuivre.) L. W. Haase. *Cuivre et Laiton*, Vol. 5, Feb. 15, 1932, pages 61-69.

Corrosion can be due to three causes: 1. free and dissolved gases, 2. organic, acid and basic salts, 3. organic compounds. The three causes and their origin are thoroughly discussed. The formation of protective films, the influence of soldering which can under certain conditions, greatly corrode the copper, application of copper in the canning and preserving industry and requirements from the point of health regulations are treated at great length. Ha (4)

Accelerated Weathering Tests of Soldered and Tinned Sheet Copper. Peter R. Kosting. *Bureau of Standards Journal of Research*, Research Paper 422, Vol. 8, Mar. 1932, pages 365-379.

The pitting and furrowing of tinned and soldered sheet Cu, which sometimes happen when weathered, were duplicated in the laboratory by exposing the Cu to a humid atmosphere, rich in SO_2 and CO_2 at 50° C. or over. The progress of corrosion was followed by means of weight losses, tensile and bend tests. Extensive pitting and furrowing occurred after the tinned and soldered specimens had been heated to high enough temperatures to cause the formation of complex Cu-Sn alloys. Furrowing reduced the strength of soldered joints and impaired markedly the fatigue properties of the Cu as measured by the number of bends needed for failure. Spilt flux may cause pitting of Cu, but the pits thus formed occur under deposits of Cu salts. A red deposit of cuprous oxide was found under these salt deposits if the Cu originally was oxidized. WAT (4)

The Behavior of Gold and Its Alloys with Silver and Copper Against Nitric Acid and Sulphuric Acid. (Das Verhalten von Gold und seinen Legierungen mit Silber und Kupfer gegen Salpetersäure und Schwefelsäure.) G. Tammann & E. Brauns. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 200, Sept. 29, 1931, pages 209-231.

The loss of weight of Au or Au-alloyed plates was greatly different according to temperature of the acids, time of action, and percent of Au in the alloy. The various testing methods and the results are described. Ha (4)

Investigations on Soldered Seams of Gold Alloys. (Untersuchungen an Lotnähten von Goldlegierungen.) H. Ziebe. *Deutsche Monatschrift für Zahnheilkunde*, No. 1, Jan. 1931, pages 1-11.

It is important, in order to obtain corrosion-proof dentures to solder only parts having the same gold content as otherwise local elements are formed which lead to corrosion. The use of 16-carat solder should be avoided as it has proved to be non-resistant. Photomicrograph of seams show the difference between good and bad soldering. Ha (4)

The Corrosion of Preserved-Fruit Tins. *Engineering*, Vol. 131, Apr. 24, 1931, page 540.

Abstract of *Special Report* No. 40 of the *Food Investigation Board of the Department of Scientific and Industrial Research* by T. N. Morris entitled: "The Corrosion of the Tin-Plate Container by Food Products." Most of the work was done on mild steel with comparative tests on Armco iron and steel sheets in various stages of manufacture. LFM (4)

Many Factors Affect Action of Milk on Metals. H. T. Gebhardt & H. H. Sommer. *Food Industries*, Vol. 3, Sept. 1931, page 397.

An interim report issued in connection with an investigation on the resistance of metals to corrosion by milk which is in progress at the Wisconsin College of Agriculture. The materials studied were Al, Ni, Cu, Zn, tinned Cu, solder-coated Cu, tinned Fe, galvanized Fe, Allegheny metal, stainless steel, Monel metal, brass and Ni-Cu-Zn alloys. From the results already obtained conclusions are drawn relative to the influence of acidity of the milk, presence of dissolved oxygen, increase of temperature and steam sterilization of the metals. WHB (4)

Cable Research in Germany. *Electrical Review*, Vol. 110, Jan. 15, 1932, page 82.

Abstract of a recently published report on the engineering and electro-chemical work of the German Post-office, which includes an account of the relation between stray currents and electrolytic corrosion. Most of all cable used today in Germany is Pb covered and paper insulated. An example of the rapidity with which an unprotected cable may be destroyed is that of a 2-strand cable of 0.85 cm. outside diameter with a Pb sheath 1 mm. thick, laid in marl soil containing 45% CaO. The cable was useless in 9 months. Type of corrosion can not be satisfactorily decided by electric measurement alone. Formation of Pb Cl_2 is probably the most characteristic chemical change in electrolytic corrosion. Existence or absence of stray currents in, or on, the cable casing does not definitely prove that there has been or has not been electrolytic corrosion. Tests showed that the detection of surface currents in the Pb sheath, even when several milliamps./dm.^{2}, is in itself no proof of the existence of electrolytic corrosion. They show also that the danger zone of stray currents has a radius of 100 m. Intercrystalline fracture, due to vibration mainly, may be overcome by the addition of 1% Sb or 3% Sn. Grain size is an important factor, but even fine-grained Pb is liable to brittleness. Addition of Sn, Sb, and Cd appears to reduce the resistance of Pb to attack by H_2SO_4, but to increase its resistance to the action of weak organic or inorganic acids, such as are likely to be found in soil. MS (4)

Contributions to the Corrosion Problem. (Beiträge zum Korrosionsproblem.) H. Erlenmeyer. *Korrosion und Metallschutz*, Vol. 8, Feb. 1932, pages 29-35.

The first half of the paper deals with the "morphology of the rust process." Many phenomena superimposing on each other in a complicated manner are involved in this process. The auto-colloid catalysis theory of Friend and the differential aeration theory of Evans are touched upon. The writer sets forth to prove why iron is liable to rust to an extent unrivaled by any other metal. The absence of a protective oxide layer is blamed first. The characteristic feature of the surface layer formed on iron during the corrosion attack is, that it contains capillaries through which the corrosion medium is admitted to the virgin metal while the corrosion products are emigrating in the opposite direction. The writer supports his opinion by focusing attention to the climbing of salts noticed at the glass walls containing certain salt solutions. KCl for instance climbs along a glass rod to a height of 60 cm. above the liquid level. Tests are reported studying the behavior of different solutions in this regard. Next the Brechhold phenomenon is discussed, i. e. the total migration of salts to the outside of ceramic bodies soaked with a salt solution, during the drying process. The latter actually does not start at the outside of the body, but in the interior regions. The writer proved the occurrence of the Brechhold phenomenon on rusting Fe by soaking it with $K_4Fe(CN)_6$ in vacuo. The capillary migration does not take place on other metals, since the capillaries are clogged by deposits at an early stage. The second half of the paper treats with the corrodibility of the system cast iron—bronze submitted to accelerated corrosion tests. The commercial importance of this problem is based on the use of bronze for welding cast iron pipes. The testing media were solutions of $Ca(HCO_3)_2$, H_2O saturated with O_2, $CaSO_4$, NaCl + $MgCl_2$, NH_4Cl, and a peat suspension. The e.m.f.'s were determined. The tests proved the appearance of corrosion in the vicinity of the welded areas. The Fe dissolved was determined and compared with the losses of the combination, steel-Monel metal. The ratio was 0.1712 g.Fe (cast iron-bronze) to 0.1383 g.Fe (steel-Monel metal) dissolved during 72 hours from 15 cm.^{2} Fe. Alternating submersion and immersion tests were performed with a testing equipment working on a 3 hours cycle and successively employing 6 different reagents. In addition to this a temperature change from 20 to 60° C. was attained by using air baths. The testing times were 4 and 10 days, the corrosion rate being determined after every 10 days by weighing the samples and analyzing the Fe dissolved. The materials employed were 2 transversely and 2 longitudinally welded samples of cast iron-bronze, pure cast iron and a combination of steel and Monel metal. The latter corroded most severely, but cast iron-bronze is also liable to pronounced corrosion attack. Cast iron with the skin unremoved was scarcely attacked during the first 20 hours, whereupon a marked corrosion started. EF (4)

Thin Films in Relation to Corrosion Problems. U. R. Evans. *Engineering*, Vol. 132, Sept. 18, 1931, page 381; *Steel*, Vol. 90, Jan. 18, 1932, page 29.

See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 4.

LFM+JN (4)

The Passivity of Chromium. II. (Zur Passivität des Chroms II.) Erich Müller & Kurt Schwabe. *Zeitschrift für Elektrochemie*, Vol. 37, Apr. 1931, pages 185-197.

The study of passivity in electrolytic Cr was extended to Cr prepared by the thermite process. The latter is more noble than the former. In the passive state a Cr surface is covered with a layer of attached oxide which prevents the action of those acids not capable of penetrating the layer because of the size of their anions. Cathodic polarization forces H-ions through the layer, dissolves the oxide and renders the Cr active. Each acid has a characteristic activation potential. The oxide layer is distended at corners and points and acids may diffuse through and dissolve the oxide. At these points the Cr is active and tends to polarize the whole surface by short-circuiting. The limit of this self-polarization is set by the rate of diffusion of the H away from the point of discharge. Only when this limiting value is greater than the characteristic activation potential of an acid, e. g., HCl, will the acid dissolve the metal. The limiting self-polarization may be increased by rubbing the surface or by raising the temperature. Thus, rubbing electrolytic Cr produces activation at room temperature in *M* HF, HBr, H_2SO_4 and $HClO_4$ but not in *M* H_3PO_4. Ha (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Contributions to a Systematic Affinity Theory. 56. The Affinity of Rhenium to Sulphur. (Beiträge zur systematischen Verwandschaftslehre. 56. Ueber die Verwandtschaft von Rhenium zu Schwefel. Rheniumheptasulfid.) W. BILTZ & FRIED. WEIBKE. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 203, Dec. 30, 1931, pages 3-8.

The equilibrium diagram Re-S is discussed and Rheniumheptasulphide determined as a stable chemical compound of a density of 4.866 ± 0.006. The similarity to the neighbor elements Os is pointed out. Ha (5a)

On the Mechanism of Eutectoid Change in Copper-Tin Alloys. H. IMAI & M. HAGIYA. *Kinzoku no Kenkyu, Japan*, Vol. 9, Feb. 1932, pages 85-96.

Eutectoid change of Cu-Sn system was observed by means of thermal analysis and the measurement of electric resistance. In tempering the specimens quenched at 700° C., a remarkable heat evolution at 200°, and a marked decrease and also increase of electric resistance at 300° and at 400° respectively were observed. These changes were most remarkable at the eutectoid composition, 27% Sn. The writer ascribed the change to the stepped transformation of β, e. i., $\beta \rightarrow \beta' \rightarrow \beta'' \rightarrow \alpha + \delta$. The change of microstructures was closely observed. The well known martensitic structure, which appears in a hypo-eutectoid bronze quenched at high temperatures, decomposes, by tempering at about 500° C., into finer crystals; the writer considers that the acicular structure is a certain intermediate phase, probably β'. In tempering the quenched specimen at 300 to 350° C., a very clear banded or laminated structure was observed in β matrix; the writer considers it β''. A structure which appears in a quenched specimen between α and β, and changes its color from dark gray to pale brown according to cooling velocity, and discussed on several occasions by Hoyt, Stockdale and Hansen, was clearly explained by the above stepped transformation. KT (5a)

Thermodynamics Applied to the Iron Carbon System. F. H. JEFFERY. *Transactions Faraday Society*, Vol. 28, Feb. 1932, pages 98-100.

The differences in deductions based on thermodynamic reasoning between Jeffery and Yap, Chu-Phay are mentioned. The author maintains that the liquid phase in equilibrium with austenite is a solution of C in Fe is the only tenable possibility. Also there is no indication of a "point saillant" at 1020° C. Since thermodynamic equations apply to dilute solutions, further experimental work may modify the curvature of solidus and liquidus between 1130° and 1487° C. (5a)

Science of Metals. VSEVOLOD N. KRIVOBOK. (Carnegie Institute of Technology). *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1143-1146.

Introduction to section on "Metallography," which begins in this issue. Outlines scope of science of metals, which may be divided into 4 fields. These are inspection, "plant research," development of new materials and alloys, and metallography. The last branch strives to answer the "why" questions with regard to the properties, behavior, and applications of metals and alloys. MS (5a)

The Curie Points. L. F. BATES. *Proceeding Physical Society*, London, Vol. 43, Jan. 1, 1931, pages 87-95.

Attention is directed to the fact that at least 3 temperatures may have to be specified in a description of the magnetic behavior of a ferro-magnetic substance. These are termed, respectively: the ferro-magnetic critical point, the ferro-magnetic Curie point and the paramagnetic Curie point. The significance of the relative positions of the last two points is discussed and it is shown that a slight extension of the view that ferro-magnetism is due to magnetic particles consisting of a group of associated atoms may account for the paramagnetic behavior of Fe, Ni and Co and for that of more complicated substances. Ha (5a)

The Diffusion of Tin into Iron with Special Reference to the Formation of Columnar Crystals. C. O. BANNISTER & W. D. JONES. *Engineering*, Vol. 132, Oct. 2, 1931, page 443.

Abstract of a paper read before the Iron & Steel Institute, Swansea, Sept. 29, 1931. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 302. LFM (5a)

A Study of the Constitution of the Iron-Tin Alloys. C. A. EDWARDS & A. PREECE. *Engineering*, Vol. 132, Oct. 2, 1931, pages 442-443.

Abstract of paper read before the Iron & Steel Institute, Swansea, Sept. 29, 1931. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 302. LFM (5a)

The System Iron—Cobalt—Tungsten (Das System Eisen—Kobalt—Wolfram.) WERNER KÖSTER & WILLI TONN (Dortmund). *Archiv für das Eisenhüttenwesen*, Vol. 5, Feb. 1932, pages 431-440.

Includes 39 diagrams. Review is made of systems Fe-Co, Fe-W and Co-W. The melts of the 3-phase system Fe-Co-W were studied up to the W content of the section Fe_3W-CoW. These 2 compounds form in the ternary system a continuous series of solid solutions. Under this hypothesis the course of the equilibrium was derived and confirmed by means of thermal, dilatometric, and structure experiments, as well as by separation hardening. The 3-phase equilibrium Liquid + W = Fe_3W_2 of the 2 phase system Fe-W decreases with Co addition to somewhat lower temperature and steadily changes over into the equilibrium Liquid + W = CoW. The equilibrium Liquid + α-Solid Solution + Fe_3W_2 of the system Fe-W takes place at still lower temperatures, until at 1465° C. the 4-phase reactions, Liquid + α-Solid Solution $\rightleftarrows$ γ-Solid Solution + δ-Solid Solution, coincides with 3-phase equilibrium of Liquid & α-Solid Solution = γ-Solid Solution of system Fe-Co, whose temperature also decreases with W-addition. Equilibrium of liquid state resulting from reaction Liquid = γ-Solid Solution + δ-Solid Solution is eutectic and is transformed in passing through a minimum temperature value, into the equilibrium, Liquid = γ-Solid Solution + CoW of the Co-W system, while 3-phase equilibrium condition of solid crystal $\alpha + \gamma + \delta$ remains constant up to room temperature. Composition of α- and γ-Solid Solution taking part in this equilibrium remains almost constant with decreasing temperature to approximately 950° C. and is then displaced strongly towards Co side, corresponding to course of the α- γ- transformation in the Fe-Co system. (5a)

The α and β Solid Solutions of the Copper-Zinc Alloys and the Corresponding Liquid Solutions in Equilibrium with them, examined thermodynamically. F. H. JEFFERY. *Transactions Faraday Society*, Vol. 28, May 1932, pages 452-455.

Both liquid and solid phases of the α field, and the liquid phase in equilibrium with mixed α and β phases and with the β phase are solutions of $CuZn_4$ in monatomic copper molecules. The β solid solution consists of $CuZn_2$ dissolved in monatomic molecules of copper. The similarity between the Cu-Sn and Cu-Zn phases as shown by X-ray methods is not substantiated by the thermodynamic method. PRK (5a)

Thermodynamic Considerations of Several Equilibrium Curves of the System Iron-Carbon. (Thermodynamisches Betrachtungen Zu einigen Gleichgewichtskurven des Zustandsschaubildes Eisen-Kohlenstoff.) FRIEDRICH KÖRBER & WILLY OELSEN. *Archiv für das Eisenhüttenwesen*, Vol. 5, May 1932, pages 569-578.

Report 179 of Committee on Materials of Verein deutscher Eisenhüttenleute. Includes 44 references and composite Fe-C phase diagram giving all values from the literature based on temperature and C content. Thermodynamic equations for deriving equilibrium lines in general 2-phase systems are calculated for the Fe-C system. The fusion and transformation lines in 2-phase systems are computed from the heat of fusion and transformation. Heat of transformation of pearlite as calculated was 20.5 cal/g., and the heat of formation of cementite amounts to between -5 and -7 K cal/mol. The major part of the C is dissolved in the melt in the form of iron-carbide molecules. The molecular state of C in γ-solid solutions cannot be definitely ascertained. A bibliography of the literature for the Fe-C system is given for each definite phase of the work. DTR (5a)

Aging Notch Toughness and Strain Figure Etching. (Alterungskerbzähigkeit und Kraftwirkungsfigurenätzung.) H. JUNGBLUTH. *Archiv für Eisenhüttenwesen*, Vol. 4, May 1931, pages 533-536.

Occurrence and causes of strain figures as revealed by Fry's etching method are reviewed. In reporting the results of his own investigations the previous results of Köster (*Archiv für Eisenhüttenwesen*, Vol. 3, April 1930, pages 649-658; see *Metals & Alloys*, Vol. 1, 1930, page 745) are referred to in particular. The author states that from Köster's findings on the relation between strain figure etching and nitrogen segregation the conclusion could be drawn that the aging properties of a material cannot be judged from the etching of strain figures. In checking Köster's tests to suppress the occurrence of strain figures by a suitable heat treatment results were obtained that are only in part in accord with those of Köster. Jungbluth shows that the strain figures can still be revealed in aging-sensible materials by deep etching after the following procedure: Annealing at 100° C. for from 30 to 100 days, cold working and a subsequent 6 hr. anneal at 100° C. The author furthermore shows that even if Köster's observations are correct, the original condition of the material can be re-obtained by annealing the material as delivered at temperatures above A_c ''' . By this normalizing the nitrogen is going again into solution. The aging is then performed in the normal way. 22 references. GN (5a)

The Equilibrium of the System FeO-MnO. J. H. ANDREW, W. R. MADDOCKS & D. HOWAT. **The Equilibrium of the Systems MnS-MnO, MnS-MnSiO$_3$ and MnS-Fe$_2$SiO$_4$.** J. H. ANDREW, W. R. MADDOCKS & E. A. FOWLER. *Engineering*, Vol. 132, Oct. 9, 1931, page 457.

See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 7. LFM (5a)

Notes on the Micrographic Structure of Metals and Alloys. (Apercus sur la Structure Micrographique des Métaux et Alliages.) L'USINE, Vol. 41, Jan. 22, 1932, pages 27-28.

The study of the micrographic structure is important as the latter is the characteristic of all physical properties. The author emphasizes the necessity and value of laboratory research in finding proper ways and developing new means in the treatment of metals and alloys to improve their properties, and cites as examples the great progress made lately in non-rusting and heat-resisting steels. He advocates for France the adoption of industrial research on the same scale as it exists in other countries. Ha (5a)

The Alloys of Iron with Tungsten. *Metallurgist*, Mar. 1931, page 46.

A review of the work of S. Takeda. See "On the Equilibrium Diagram of the Iron-Tungsten System," *Metals & Alloys*, Vol. 2, June 1931, page 111. VVK (5a)

The Crystal Structures of the Compounds Occurring in the System of Sb-Cd (Ueber die Kristallstrukturen der im System Sb-Cd auftretenden Verbindungen). E. ABEL, J. ADLER, F. HALLA & O. REDLICH. Remarks to the paper of same title by M. CHIKASHIG & T. YAMAMOTO. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 205, May 3, 1932, pages 398-400.

The non-existence of a second modification of CdSb and the existence of the metastable compound Cd_3Sb_2 are maintained against the arguments of the 2 other investigators. Ha (5a)

Metallographical Experiments of Ternary Alloys of the System Iron-Tungsten-Carbon. (Metallographische Untersuchungen der ternären Legierungen des Systems Eisen-Wolfram-Kohlenstoff.) W. KÖSTER. *Stahl und Eisen*, Vol. 52, Mar. 10, 1932, pages 241-243.

See "A Metallographic Investigation of the Ternary Alloys of Fe-W-C System," *Metals & Alloys*, Vol. 2, Jan. 1931, page 5. DTR (5a)

The Chromium-Iron Equilibrium Diagram. *Metallurgist*, Sept. 1931, pages 139-140.

A critical review of an article by Wever & Jellinghaus. See "The Binary System Iron-Chromium," *Metals & Alloys*, Vol. 3, Apr. 1932, page MA 91. VVK (5a)

Status of Metallography. *Heat Treating & Forging*, Vol. 18, Feb. 1932, page 136; Mar. 1932, page 202.

From a brochure published by Bausch & Lomb Optical Co. Points out the uses of metallography for determination of approximate composition, identification of structure, measurement of grain size, and detection of defects and inclusions. MS (5a)

A Critical Study of the Origin of the Banded Structure of a Hot-Worked Hypo-Eutectoid Steel. F. G. THOMPSON & R. WILLOWS. *Engineering*, Vol. 132, Oct. 16, 1931, pages 485-486.

See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 34. LFM (5a)

Structure & X-Ray Analysis (5b)

Precision Measurements for the Lattice Constant of Columbium. (Präzisionsmessung der gitterkonstante von Niob.) M. C. NEUBURGER. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 197, No. 2, 1931, pages 219-223.

An especially pure sample of Cb was accurately tested by an X-ray method. The results agree with those previously reported. The edge of a cubic body-centered crystal is calculated to be 3.303 ± 0.002 A. U. from which the sp. gr. 8.56 is obtained as compared to 8.55 by direct measurement. Ha (5b)

On the Lattice Constants of Rhenium. (Zu den Gitterkonstanten des Rheniums.) K. MOELLER. *Naturwissenschaften,* Vol. 19, June 26, 1931, page 575.

The lattice constants of rhenium have been determined by a special precision method: a = 2.755 A. U., c = 4.450 A. U. WHB (5b)

An Attempt to Activate Adsorbed Mercury Atoms by Ultra-Violet Light. L. H. REYERSON. *Physics,* Vol. 2, Feb. 1932, pages 70-72.

Mercury atoms adsorbed on catalytically active extralattice Cu atoms are not activated by the light from a mercury lamp sufficiently to cause a reaction to occur between hydrogen and ethylene. Mercury in the vapor state under similar conditions does cause such an action to take place. (5b)

The Determination of the Solubility of Manganese in Magnesium by X-Rays. (Röntgenographische Bestimmung der Löslichkeit von Mangan in Magnesium). E. SCHMID & G. SIEBEL. *Metallwirtschaft,* Vol. 10, Dec. 4, 1931, pages 923-925.

Contains 5 references. The lattice constants of Mg containing from 0 to 2.5% Mn were determined by a precision method. The samples were heated to 600° C. and quenched. To determine the solubility of Mn in Mg, samples containing up to 3.7% Mn were quenched at 600 to 645° C. and reheated to 350 to 635° C. and examined by means of X-rays. The solubility curve drops from the eutectic of 3.4% Mn at 645° C. sharply to practically O at 200° C. Photomicrographs of the 3.7% Mn alloy quenched from 600° C, and reheated to 500° C. are shown. CEM (5b)

A New Graphic Method for Assigning Indices of Powder Photographs. (Ueber eine neue graphische Methode zur Indizierung von Pulveraufnahmen.) E. SCHNEIDER. *Zeitschrift für Kristallographie,* Vol. 78, July 1931, pages 503-510.

A graphic method including a mathematical proof is described confining itself, like the Hull-Davey method, to the special case, that the quadratic form has only two coefficients. In contrast with Hull-Davey, the writer exclusively employs straight lines, resulting in a quick and easy performance of the drawings. EF (5b)

The Transformation of Cobalt. (Über die Umwandlung des Kobalts.) G. WASSERMANN. *Metallwirtschaft,* Vol. 11, Jan. 29, 1932, pages 61-65.

Includes 20 references. Technical Co containing 1.94% Ni, 1.84% Fe and .64% Mn was hot rolled, then cold rolled to .2 mm. thickness. X-ray examination disclosed that it had a hexagonal structure, similar to Mg. When heated to above 450° C. the structure became cubic. The transformation is independent of the time of heating and rate of cooling. The only ways to recover the hexagonal structure are to cold roll again or to anneal at high temperatures, recrystallizing the metal. The transformation temperature was also checked by determining the change in thermal expansion in the Co sheet and in single crystals of technical and c.p. Co. The transformation takes place without any change in the crystal boundaries and can be considered a simple shifting, 2 atoms being included in 1 molecule. Co is suitable for the study of various transformation problems due to the absence of foreign atoms. A transformation point at 1015° C. which has been reported by other investigators does not exist. CEM (5b)

The Influence of the Crystal-Orientation of the Cathode on that of an Electrodeposited Layer. W. A. WOOD. *Proceedings Physical Society, London,* Vol. 43, Pt. 2, Mar. 1, 1931, pages 138-141.

The influence of the crystal-orientation of a cathode on that of an electrodeposited layer is studied by X-ray methods for the cases of Cu and Ni, respectively, deposited on rolled Cu. The conditions of cathode surface and current density which accompany an oriented deposit are determined. The orientation of the Cu deposit for small currents is the same as that of the cathode. The Ni, at low current densities, assumes a distinct orientation. As the current is increased there is a region of no orientation, followed, at still higher currents, by an orientation the same as that of the cathode surface below. Ha (5b)

The Excitation Potentials of Light Metals. H. W. B. SKINNER. *Proceedings Royal Society,* Vol. 135A, Feb. 1932, pages 84-108.

The critical potentials of metallic Li have been determined. They consist of some low-voltage potentials and the critical potentials corresponding to the excitation of Li K-radiation. The radiation emitted by metallic Li has been studied by the photoelectric method. The general characteristics of the spectrum of photoelectrons ejected by the radiation from Li are in accord with those found by Rudberg, by a different method, for other light elements. The photoelectrons which have energy corresponding to only a few volts largely predominate. A numerical comparison is satisfactorily achieved between the observed critical potentials of Li metal and the calculated energy levels of the free Li atom. The existence of a radiation potential for the metal was rather unexpected on account of the fact that the lowest valence states in the metal have to be supposedly filled with electrons; but it is shown that the ionisation of the K-shell alters the levels in the metal in such a way that there are empty levels around the ionised atom into which the K-shell can switch. Though irrelevant to the case of Li it is shown that the effects of the crystal-lattice on the motion through it of (a) the incident electron-beam which is used for the excitation of the radiation, and (b) the electrons which are thrown from a K-, L-, or M-shell in the excitation process, may have an important bearing on the interpretation of soft X-ray discontinuities. It is shown that the true probability for a given excitation process of an atom in a solid varies with the voltage of the exciting electron in a way quite analogous to the variation of the excitation function for the corresponding process in the case of a free atom. (5b)

On a Novel X-Ray Method for Investigating Crystal Lattice Distortions. (Über eine röntgenographische Methode zur Untersuchung von Gitterstörungen an Kristallen.) W. BERG. *Die Naturwissenschaften,* Vol. 19, May 8, 1931, pages 391-396.

Pictures of crystal surfaces are secured by using an X-ray pencil perpendicular to the surface and photographic plate. Those pictures are composed of a system of stripes, which are light and dark. It is shown that stripes resulting from space lattice distortions are encountered parallel to the cubic sides and at 45° to them. The stripes can be obtained artificially by pressure if the internal stresses of the crystals were released by proper heat treatment. In natural crystals stripes due to slip were detected. EF (5b)

X-Ray Analysis of Light Aluminum Alloy Stamping. E. F. BACHMETEW. *Transaction of the Central Aero-Dynamical Institute,* No. 110, 1931, 27 pages. (In Russian.)

Several die forgings of light Al alloys were investigated by X-rays in order to determine the applicability of the method for inspection of light metal forgings. Diffraction method seems to be more promising in the determination of cold work. It gives fuller information than metallographic means but drawing proper conclusions is strongly handicapped by the complexity of the phenomena entering the working o. metals. (5b)

X-Ray Inspection Required for Welded Boilers. RICHARD K. ATKIN. *Machinery,* Vol. 38, Jan. 1932, pages 353-354.

Discusses the regulation of the A.S.M.E. Boiler Construction Code, in regard to X-rays of welds. For all plate thicknesses of 3" or less all welded joints must be X-rayed with apparatus capable of determining quantitatively the size of a defect with a thickness greater than 2% of the thickness of the baseplate. The Robert W. Hunt Co. has equipped a laboratory for this work. RHP (5b)

The Atomic Scattering Power of Iron for Various X-Ray Wave-Lengths. A. J. BRADLEY & R. A. H. HOPE, *Proceedings Royal Society,* Vol. 136A, May 1932, pages 272-288.

An experimental investigation has been made of the atomic scattering factor of Fe using X-rays of different wave-lengths. Powder photographs of the alloy FeAl were made with Mo, Cu, Fe and Cr radiations, and the intensities of the lines were measured photometrically. The reflections are of 2 types, Fe + Al and Fe — Al. It was therefore possible to deduce relative f curves for Fe and Al. By reducing the Al f curve to the same scale as Hartree's f curve, and introducing a temperature factor, the observations were made absolute. By this means absolute values of the atomic scattering factors of Fe and Al were obtained for different values of sin θ/λ. It was found that the f curves for Al overlay almost exactly at all angles; this provides a check on the accuracy of the method. The Fe f values for each radiation were compared with the f values calculated by James and Brindley, using the Thomas method. For Mo and Cr radiation the observed results agree closely with theory between sin $\theta/\lambda = 0.2$ and 0.3. For larger angles the observed values for Mo fall very slightly below the calculated values (about 0.3 units). The f values for Cu, Co and Fe radiations are considerably less than the Thomas values. The difference in f for 2 radiations is almost independent of the angle of reflection. The f values fall in the following sequence: Mo, and Cr, Cu, Fe, Co. The value for Cu is about 0.5 units, for Fe about 1.5, and for Co about 3 units below that of Mo and Cr. The results indicate that away from the absorption edge the Thomas formula is applicable to Fe, but in the neighborhood of the absorption edge the scattering power falls off. The effect is very important at large angles where the f value for Fe is, in proportion, much more seriously diminished than at small angles. WAT (5b)

Cold Rolled Duralumin. E. F. BACHMETEW. *Transactions Central Aero-hydrodynamical Institute,* No. 109, 1932, 40 pages. (In Russian.)

The influence of cold deformation up to 96.3% on duralumin was investigated by mechanical, metallographic and X-ray methods. Sheets were used as samples. Brinell method furnished hardness figures. To about 30% elongation no definite orientation of crystalline units takes place. In the range 30-70% a definite orientation occurs along the axis which can be defined as 38°, 55° and 77° from the edges of the cube [100] [010] [001]. The strength of the metal increases here with the amount of cold deformation. Above 70% the axis of orientation changes towards [111] reaching with 93.6% deformation a position expressed by 46°, 53° and 67°. Structural changes could not be followed by metallographic means but were clearly distinguishable in X-ray testing. (5b)

The Crystal Structure of β-Zirconium. (Die Kristallstruktur des β-Zirkons.) W. G. BURGERS. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 205, Apr. 8, 1932, pages 81-86.

The crystal structure of the β modification of Zr which is stable above 862° C. was determined by X-rays. It was found to be cubic-space-centered with 2 atoms in one elementary cell with $a = 3.61$ A.U. at a temperature slightly above the transformation point. The special camera used in the tests is described. 11 references. Ha (5b)

The Problem of Retarded Phase Changes in Iron-Nickel Alloys. (The High Permeability of Air-cooled Permalloy.) [Zur Frage unterkühlbarer Zustandsänderungen in Eisen-Nickellegierungen. (Die hohe Permeabilität von luftgekühltem Permalloy.)] O. DAHL. *Zeitschrift für Metallkunde,* Vol. 24, May 1932, pages 107-111.

It is found that the changes in magnetic behavior upon heat-treatment of Fe-Ni alloys from 50-90% Ni are accompanied by changes in electrical resistance and strength. Tables and curves are given showing these correlated changes in properties. It is believed that these phenomena are caused by a change in atom arrangement, taking place below 600° C., from a random distribution of atoms to a regular one, similar to that obtaining in the alloy of the composition $AuCu_3$. Compounds $FeNi_3$ and $FeNi_2$ are probably effective. The assumption of Honda that on slow cooling the normal solid solution state obtains, characterized by a low initial permeability, is not confirmed. The magnitude of the changes in properties is influenced strongly by additional alloying elements; the effects of Mn and Si have been studied. The alloy Perminvar is shown to be affected by the type of change described. RFM (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Investigations on Supra-Conductivity. (Untersuchungen der Supraleitfähigkeit.) W. J. de Haas *et al.* (University of Leyden) *Die Naturwissenschaften*, Vol. 20, Jan. 8, 1932, pages 37-38.

Measurements on single crystals of Sn disclosed an abrupt transition from the normal to the supra-conducting state. A discontinuity otherwise observed is ascribed to defects in the material and to magnetic disturbances. The magnetic boundary value of the supra-conductivity was studied in Pb and Bi. In, Tl and Gr also exhibited the phenomenon of supra-conductivity as well as Th, Ti and Zr. EF (6)

Friction Tests on Bearing Plate Materials. Th. E. Stanton. *Engineering News Record*, Vol. 106, June 25, 1931, pages 1058-1060.

Different Sn bronzes, non-rusting steel and concrete were investigated as material for plates on which the free end of a bridge rested to be able to follow the expansion by heat. The friction coefficient increased very greatly up to 200 strokes per minute, after this only little. Lubricants reduce the friction about 20%, the best lubricant proved to be asbestos packing, especially for the concrete plates. On the basis of these tests the laboratory of highways in California adopted a soft Pb-bronze of 78.5 to 87.5% Cu, 9 to 11% Sn, 9 to 11% Pb, 0.05 to 0.25% P and 0.75% Zn for such plates with asbestos packing. Ha (6)

Hardness of Chromium as Determined by the Vickers-Brinell, Bierbaum and Mohs Methods. R. Schneidewind. *Transactions American Society for Steel Treating*, Vol. 19, No. 2, 1931, pages 115-140.

Discussion. Printed as Preprint No. 2, 1931. See *Metals & Alloys*, Vol 3, Feb. 1932, page MA 37. WLC (6)

Notch Effect on Deflection Rods. (Kerbwirkung an Biegestäben.) E. Siebel. *Stahl und Eisen*, Vol. 52, May 19, 1932, pages 494-495.

In the vicinity of a notch or indentation in a bar, rather high local stresses are set up and it is only in a few cases that it is possible to determine all existing stresses with certainty. G. Fischer used elongation measurements over the entire length of a bar as an indirect measure of distribution of stresses. From graphs showing % elongation against increasing notch radius with constant notch or indentation depth, also % elongation against varying notch depth with constant radius, for both round and semi-cylindrical notches, it may easily be seen that the maximum elongation occurs at the center of the notch, with steep slopes up to and away from the maximum. The maximum values for elongation drop with decreasing depth of nick and increasing radius of notch, the curves flattening out similarly. Notch number α_k is given for varying notch depths from 0 to 25 mm. and radii from 0 to 25 mm. DTR (6)

New Machining Methods. (Neues Zerspannungsverfahren.) O. P. van Steewen. *Maschinenkonstrukteur-Betriebstechnik*, Vol. 65, Jan. 10, 1932, pages 3-4.

A new kind of rigid automatic machine made by the Loewe Gesfürel A.-G. according to the Mulka patent operates in a way opposite to the rotating method usually used where the piece turns longitudinally. Here the piece travels along, being punched from 4 directions, 90° apart, at once, by a part which extends the whole length of the test piece. Time is saved, and also, more satisfactory operation is accomplished since the 4 punching meters wholly support the test piece, preventing the occurrence of vibrations. MAB (6)

Two Kinds of Elongation Discriminated in Plastic Deformation of Metals. Ryuzaburo Taguti. *Scientific Papers Institute of Physical & Chemical Research*, Vol. 18, Apr. 1932, abstract page 60.

By the photoelastic method of studying deformations within the elastic limit the cracks occurring in the material in the district of the strain figures and elsewhere seem to point to different kinds of elongation. Tests were made on brass, Al, Zn, Ni and other metals. An explanation on the basis of the crack analysis is attempted. Ha (6)

Modern Practice in Cast-Iron Testing. H. W. Swift. *Foundry Trade Journal*, Vol. 46, Mar. 17, 1932, pages 173-175; Mar. 24, 1932, pages 187-190.

Discusses the British, American, German and French standards for the testing of cast Fe in some detail, following this discussion by consideration of the choice of testing methods suitable for particular cases. The importance of the mass effect upon the mechanical properties of the test pieces and the necessity for careful methods of sampling are referred to. A very full discussion of tensile, transverse, shear, hardness, and impact tests concludes the paper. OWE (6)

The Wear of Cast Iron. A. A. Timmins. *Foundry Trade Journal*, Vol. 46, Apr. 7, 1932, pages 216, 223.

After discussing various methods of testing wear, the author deals with the various explanations which have been put forward for the resistance of cast Fe to wear. The importance of the phosphide eutectic in this connection is dealt with at some length, and the influence of glazed surface on cast Fe is referred to. The article is accompanied by 2 photomicrographs. OWE (6)

Tests of Alloy and Heat Treated Carbon Rail Steels. J. B. Young. Appendix K to report of Rail Committee. *Bulletin American Railway Engineering Association*, Vol. 33, Feb. 1932, pages 573-576.

A considerable number of transverse fissures, and split and crushed heads, are reported in intermediate Mn rails now in experimental use. The fissure failures appear to be due to a martensitic structure in the head of the rail. Over 700,000 tons of such rails are in American track. Compositions varying slightly from those previously used are being tried out. Only 5,000 tons of heat-treated rails were purchased in 1931, most of these going to the Pennsylvania, the balance to the C. & O. and the Reading. Several heat-treated rails laid in 1931 developed head failures due to quenching cracks, so that all the rails were returned for a proof test, in which the rail is passed between staggered rollers so that the rail is bent nearly to its elastic limit. Under this test, cracks or quenching strains will cause the rail to break, so that those passing the test are expected not to show premature failure in service. HWG (6)

Fatigue of Metals & Alloys (6f)

The abstracts appearing under this heading are prepared in coöperation with the A.S.T.M. Research Committee on Fatigue of Metals.

The Behavior of a Single Crystal of Aluminum under Alternating Torsional Stresses While Immersed in a Slow Stream of Tap Water. H. J. GOUGH & D. G. SOPWITH. *Proceedings Royal Society*, Vol. 135A, Mar. 1932, pages 392-411.

The tests involve the study of a single crystal only. The effect of the intercrystalline boundary and crystal size on corrosion-fatigue form the subject of further investigations not yet completed. No effort is made to correlate the results of the present work with those previously obtained in tests on crystalline aggregates by other workers. One very important aspect, however, may be remarked. Arising from tests made on crystalline aggregates, the opinion has been expressed that failure by corrosion-fatigue is due primarily to the stress-concentration effects caused by corrosion pits or notches due to general or local attack. But the present results show that, as far as a single crystal is concerned at any rate, this is not the case, but that the cause of failure is directly related to the crystalline structure. This is the more satisfactory explanation, as failure under ordinary fatigue and corrosion-fatigue conditions are now shown to be directly related. Many fatigue experiments on single crystals of Al, Fe, Ag, etc., have shown that fatigue cracks always originate in regions which have been plastically deformed thus leading to the conclusion that fatigue failure, in such cases, is a consequence of the break-up of the crystal structure resulting from slip. If, as in corrosion-fatigue, a corrosive action is superimposed on the stress effects applied in ordinary fatigue tests, it would appear most probable that these actions would be mutually accelerative, and that failure would; in this case also, be most marked in the plastically deformed areas. The present experiment has shown that this actually occurs, and this result is of great importance as affording some fundamental information regarding corrosion-fatigue phenomena which could only be obtained from single crystal tests. A corrosion-fatigue test on a single crystal where the applied cycle of stress is such as would not normally produce plastic deformation would afford an interesting comparison with the present experiment. A crystal of Fe would be suitable for this purpose, and it is proposed to carry out an experiment on such a crystal. WAT (6f)

Accelerated Cracking of Mild Steel (Boiler Plate) Under Repeated Bending. W. ROSENHAIN & A. J. MURPHY. *Engineering*, Vol. 131, May 22, 1931, page 680.

Abstract of paper read before the Iron & Steel Institute, London, May 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 247. LFM (6f)

The Failure of Steel Components by Fatigue. H. W. KEEBLE. *Iron & Steel Industry & British Foundryman*, Vol. 5, Jan. 1932, pages 165-170.

11 references. A consideration of the causes of fatigue failure in which the discussion of the most prolific cause of failure, namely, stress localization, is divided into treatments of the effect of surface condition, of design and of the material. A fine surface finish, the use of generous fillets, and the use of clean steel will bring about a decrease in the number of fatigue failures. CHL (6f)

Steady Torsion Combined with Alternating Bending. J. B. KOMMERS. *Engineering*, Vol. 132, Aug. 28, 1931, page 249.

Equations are given for developing the criterion for determining what value of constant shear stress may be combined with a given value of alternating tensile and compressive stress, so that the fluctuations of stress on any inclined plane shall not exceed the value *a* defined in the following equations.

$$a = S_{-1}\left(1 - \frac{S}{u}\right) \text{ when S is tensile stress}$$

$$a = S_{-1}\left(1 - \frac{2S}{u}\right) \text{ when S is compressive stress}$$

a = the alternating unit stress, or semi-range of stress;
S_{-1} = the endurance limit for completely reversed tensions and compression;
S = steady stress, or mean stress, which equals the maximum stress plus the minimum stress divided by 2.
u = ultimate tensile strength. LFM (6f)

Influence of Direct Current Magnetizing on Damped Materials during Rotary Oscillations. (Einfluss der Gleichstrom-Magnetisierung auf die Werkstoffdampfung bei Drehschwingungen.) A. ESAU & H. KORTUM. *Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 2, Dec. 1931, pages 429-434.

Describes the test set-up and gives the results of tests with a) rolled Fe, b) electrolytic Fe, c) steel, d) alloy steel, e) Ni, f) Fe-Ni alloy. The conclusion arrived at is that the influence of magnetizing is very marked on the materials tested. In Fe and steel a decrease in damping, which approaches a limit (saturation) more or less rapidly, takes place up to a certain deformation. In Ni and in an Fe-Ni alloy an increase and then a decrease in damping occurs. The difference between Fe and Ni, however, appears to be only quantitative, since in Fe the change proceeds in a similar way only with greater deformation. The damping curves of pure metals indicate extreme values or a turning point without magnetization. These extreme values vary with increased magnetization. Annealed and unannealed electrolytic Fe shows similar qualitative damping changes. Variations in frequency appear to follow the same laws as those for variation in damping. MAB (6f)

American Views on Life and Accuracy of Springs for Measuring Instruments. (Amerikanische Anschauungen über Lebensdauer und Genauheit von Federn von Messgeräten.) F. MOELLER. *Die Messtechnik*, Vol. 8, Feb. 1932, pages 32-34.

Recent American investigations of fatigue phenomena and the corresponding endurance strength are reviewed and for a series of ferrous and non-ferrous materials numerical values of the endurance strength are given. The concepts of dynamic formability, hysteresis and creep are defined. The experiments of Sayre and the dependence of the elasticity modulus on the stress resulting from them are discussed. 20 references. Ha (6f)

Fatigue Fractures and Fatigue Strength. (Dauerbrüche und Dauerfestigkeit.) R. MAILÄNDER. *Krupp'sche Monatshefte*, Vol. 13, Mar. 1932, pages 56-81.

The characteristic signs of fatigue fracture, the nature of fatigue strength and the methods for their determination are discussed from the point of view of the operating and designing engineer. From numerous investigations a diagram is developed which shows the average bending-vibrating strength as a function of the tensile strength. Another diagram gives the fatigue strength for other types of stresses. The fatigue strength of ordinary structures can be easily determined by means of these curves; the actual determination of the fatigue strength by tests is very expensive and pays generally only for high grade materials which must be utilized to the extreme limit. If that is done, the value thus obtained must still be modified by taking into account the influence of machining methods. How this can be done is briefly explained. A number of failures is shown in photographs and the reasons for them pointed out. Ha (6f)

Endurance of Light-Metal Sand-Cast Alloys. (Die Dauerfestigkeit der Leichtmetall-Sandguss-Legierungen.) W. SARAN. *Mitteilungen der deutschen Materialprüfungsanstalten*, 1932, No. 12, page 184.

Abstract. For abstract of original article see *Metals & Alloys*, Vol. 2, Oct. 1931, page 215. HWG (6f)

The Spring Problem in Vehicles. (Das Problem der Fahrzeugfederung) *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 22, Apr. 10, 1932, pages 196-197.

The article deals in particular with the testing of springs, describes and illustrates new machines for dynamic spring testing and calls attention to the problem of fatigue in general. GN (6f)

Finishing (Feinbearbeitung). *Schweizerische Technische Zeitschrift*, Vol. 29, Mar. 10, 1932, pages 144-146.

The article deals with 3 various possibilities of finishing machined parts: (1) finishing with diamond or hard metal tools, (2) grinding or polishing, (3) pressing of the surface, as it has been suggested by Föppl in order to increase the mechanical properties. The last method is particularly suitable to increase the fatigue properties. GN (6f)

Measurement and Indication of Internal Energy Absorption of Materials. (Messung und Kennzeichnung der inneren Arbeitsaufnahmes von Werkstoffen.) WILHELM SPÄTH. *Archiv für das Eisenhüttenwesen*, Vol. 5, May 1932, pages 587-590.

When a material is periodically worked between 2 limiting values in definite time periods, a certain part of the applied energy is consumed in each cycle of the load, the amount of this energy or work used up varying largely with limiting values of the load applied and with a number of other conditions. The consumption of energy is tied up with fatigue or endurance properties of materials. One of the oldest methods for determining the consumption depended on measurement of the temperature rise, which resulted under repeated loadings. A calorimetric evaluation in heat units or watt-seconds was the determination, which was converted into a volume or weight unit of the material. In this paper an electrical study was made of insulating materials, in which hysteresis and phase curves were plotted. The equation $N = 1/2\ P.V.\delta$ was derived in which δ denoted the phase angle between total force P and amplitude A, also $V = A \times W$, where W denotes frequency. Maximum instead of average values are used for stress P and velocity V. The angle δ has been designed as "Angle loss" and specifies the phase displacement which takes place in a test piece between the Sine curve—fluctuating load and the resultant change in form produced thereby. The angle loss is independent of the dimensions of test sample and offers a comparatively simple method of calculation for permanently or continuously loaded materials. Its value varies theoretically between 0° and 90° or between 0 and $\frac{\pi}{2}$. This method is an advantageous one, since it gives energy loss during an entire fatigue or endurance test. A simple measuring device for torsion vibration testing is described. DTR (6f)

Plastic Strain in Relation to Fatigue in Mild Steel. B. P. HAIGH & T. S. ROBERTSON. *Engineering*, Vol. 132, Sept. 18, 1931, pages 389-390.

Reports fatigue tests on specimens of steel of chemical content 0.16 C, 0.18 Si, 0.75 Mn, 0.053 S and 0.033 P. The endurance limit under completely reversed axial load was found to be 31,000 lb./in.². In a second series of these the endurance limit was found for a range of stress from 25,000 lb./in.² compression to 40,000 lb./in.² tension. Tests were made on specimens 0.5" diameter in each of which had been bored a radial hole .031" diameter. Endurance limits were found for completely reversed stress at 17,000 lb./in.² and for a range of stress from 1000 lb./in.² compression to 28,000 lb./in.² tension—about half the strength for unpierced specimens. For the particular steel tested the tests indicate that a superposed steady stress up to 8000 lb./in.² has little effect on the critical *range* of cyclic stress for the metal. 2 special experiments gave some indication that the disturbance caused by the early stages of plastic strain reduce the resistance of the metal to repeated stress, at least when fatigue tests follow immediately after plastic strain. After a period of rest this reduction of fatigue strength by plastic strain was found to be less. HFM + LFM (6f)

Suggestion for the Fixation of the Permissible Stresses in Mechanical Engineering. (Vorschlag zur Festlegung der zulässigen Beanspruchungen im Maschinenbau.) FR. P. FISCHER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 76, May 7, 1932, pages 449-455.

The most recent results of investigations of alternating stresses have shown the necessity for making new specifications for admissible stresses. It is suggested to express the permissible stress as a function of the alternating bending strength of a polished sample and of the tensile strength, and to take into account practical conditions of the individual case by reductions from this value. Examples show how this method works out in comparison with the older, mostly static methods of determining the permissible stress. Ha (6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

The Definition and Determination of Free Cyanide in Electroplating Solutions. W. Blum. *Metal Industry,* New York, Vol. 29, Nov. 1931, pages 484-485.
See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 11. PRK (7a)

The Structure of Electrodeposited Metals III. Leslie B. Hunt. *Metal Industry,* London, Vol. 40, Jan. 8, 1932, pages 40-42.
A discussion of various theories regarding the mechanism of metal deposition and the effect of current densities on the structure. PRK (7a)

Modern Nickel Plating. (Neuzeitliche Vernicklung.) Herbert Kurrein. *Chemiker-Zeitung,* Vol. 56, Feb. 3, 1932, pages 93-94; Feb. 10, pages 114-115.
The presence of H has a large influence on the quality of Ni plating. H alloys with Ni, hardens and embrittles it. H also diffuses from the Ni into the Fe. The formation of H in the bath and absorption in the Ni deposit depends on the current density, acidity and conductivity of the salts and the pH of the solution. An ammeter and pH determinations are essential to satisfactory plating. Electrolytic Ni gauze anodes give best results. For still baths used at ordinary temperatures the pH should be 5.8 to 6.2, for hot, concentrated baths 4.8 to 5.3. The addition of HNO_3 up to .085 g. per L. or $KMnO_4$ up to .175 g. per L. helps to keep down H formation. The Fe content should not be over .60%. The Ni must cover the Fe or brass completely and be free from pin holes because it is electro-positive to both Fe and Zn. The minimum thickness of the deposit should be .025 mm. For still, cold baths 0.5 amp./dm.^{2} for 4 hours should be used. These have been largely replaced by solutions of 250 g./L. Ni_2SO_4 at 1 to 2 amps./dm.^{2} and 30° C. or 450 g./L. Ni_2SO_4 at 4 to 10 amps./dm.^{2} and 45 to 55° C., the latter with circulation and filtration of the solution. The anodes should be of high purity and solubility. Good control of all variables and frequent and rapid tests are necessary. Automatic temperature control is desirable. The hardness of electroplated Ni has been determined and varies from 155 to 420 Brinell. Brittleness and tensile strength tests have been devised but are not often used. The usual tests consist of salt spray and thickness determinations. As a preliminary coating for Cr, Ni plating must be of good quality. Al and its alloys must be roughened by etching before Ni plating. When plating Zn high current density must be used at the start. Ni-Cu and Ni-Co alloy coatings can now be plated. CEM (7a)

Effect of Concentration of Electrolyte on the Formation of the Anodic Film on Aluminium. Shoji Setoh & Akira Miyata. *Rikagaku-Kenkyusho* (Bulletin of the Institute of Physical & Chemical Research), Vol. 11, No. 2, 1932, pages 317-382.
Gives results of theoretical investigations into the phenomena in the electrolytic preparation of the oxide coating on Al in oxalic acid solutions. Conclusions are as follows. Greater part of the terminal voltage is taken up by the "Active Layer" of the anode, which consists mainly of Al_2O_3 and of pores filled with oxygen. The oxide coating obtained is the residue of it. The thickness of the layer is proportional to the voltage drop in it, irrespective of other conditions. When the concentration, the temperature and the current density are kept constant, the thickness increases with time until a certain point is reached, after which the rate of increase becomes much retarded. The voltage corresponding to this point is called the critical voltage and the quantity of electricity that has passed through unit area of the anode by that time is constant, being independent of the concentration and the current, but it increases with rise of temperature. The higher the concentration and the temperature are, the thicker is the active layer and the more resistant is the coating thereby produced against chemical actions. Judging from the thickness of the active layer, the diameter of the particles which constitute the oxide coating is presumed to be of the order of 10^{-5} - 10^{-6} cm., which is nearly in the same order as colloid particles. The volume of oxygen evolved is proportional to the product of the critical voltage and the square of the current density. This implies that there exist cylindrical pores in the active layer of which the cross sectional area is proportional to the current density and that the oxygen fills it up successively with the growth of the layer. In the case of a.c. the thickness of the layer is smaller than that corresponds to its maximum voltage. The active layer is more fragile when subjected to an electric field and at higher temperatures, it is so even when the field is absent. The apparent specific gravity of the oxide coating is nearly 3.0. The current efficiency of the formation of the coating is best at 15 ma./cm.^{2} or, if current is kept constant, at 50 to 60 volts, amounts to 80%. Prolonged electrolysis lowers the acidity until $Al(OH)_3$ precipitates out, the coating obtained resembling a white enamel and necessitating a high voltage to be applied. Too concentrated solution is unfavorable as the oxalic acid deteriorates and the coating obtained assumes a yellowish color. YO (7a)

Preparation of Steel Prior to Electroplating. G. B. Hogaboom. *Monthly Review, American Electroplaters Society,* Vol. 19, Jan. 1932, pages 26-39; *Metal Industry,* N. Y., Vol. 30, Feb. 1932, pages 59-61.
Includes discussion. Paper before Philadelphia Branch Annual Meeting, Nov. 21, 1931. For cold rolled or polished steel, a 37% H_2SO_4 is used with steel parts as cathode, 1-3 min. is required. For removing scale from hot rolled or forged steel, a special process called Hanson-Munning Bright Dip is used, which removes scale, dirt and tarnish in 3-5 min. Composition of the special bright dip is not mentioned. PRK + LCP (7a)

On the Throwing Power of Electroplating Solutions. Seiji Kaneko. *Journal Society of Chemical Industry,* Japan, Vol. 35, Apr. 1932, page 146B.
The author defines the throwing power of solutions with formulae obtained from calculations in which he uses the quantity of metal deposited in unit time, the distance between the electrodes, the current density at the cathode, the current efficiency, and the voltage drop at the cathode as his factors. MAB (7a)

Electrometallurgy (7b)

The Development of Electrolytic Metal Extraction Processes at the Norddeutsche Affinerie at Hamburg. (Le developpment des procedes electrolytiques d'extraction des metaux a la "Norddeutsche Affinerie," a Hambourg.) Walter Schopper. *Journal du Four Electrique,* Vol. 41, May 1932, pages 171-179; *Metallgesellschaft,* Apr. 1932, pages 29-39.
Electrolytic separation of Cu began at this plant in 1871 and gradually expanded until now the Cu refining department comprizes 1252 cells and had an annual production in 1930 of about 70,000 tons. The use of superimposed alternating current for electrolysis of Au proposed by H. Wohlwill eliminated troubles of anode coating so that at present on refining 98% Au the plant obtains 2-3% of the precipitates and 3-4% of anode mud. The usual production was about 3000 kg. of fine Au per month but at the present it has dropped to 500 kg. per month. Ag is refined by a special method developed at the plant and the installation was capable of daily production of 1200 kg. of refined Ag though at the present only 140,000-150,000 kg. are refined a year. Electrolytic refining of bismuth from HCl solution began in 1898 and at the present the plant makes more than 2500 kg. Bi per month. It was found that instead of segregation of small amounts of Bi produced during different refining operations it is more advantageous to alloy them as soon as produced with Pb until the Bi content is 0.8-1.0% and then to electrolyse the Bi. Slimes containing all Bi are cast into anodes for Bi electrolysis. Pb refining plant has a capacity of 150-200 tons a month. Sb is refined in concentrated H_2SO_4 bath to which is added antimony fluoride and HF producing Sb 99.8 pure. A secret process for Cd refining produced 39.3 tons of Cd in 1930-31. Ha + JDG (7b)

Metal Reclamation. C. Campbell. *Electrical Review,* Vol. 109, Dec. 25, 1931, page 961.
Describes electrolytic recovery of precious metals from rich Cu bullion. Electrolysis is conducted in Pb-lined earthenware troughs, several being employed. Surplus electrolyte flows into an adjacent Pb-lined wooden box. It is necessary to maintain a constantly flowing and heated electrolyte, containing 10% H_2SO_4 and 4% Cu. Anodes, consisting of the Cu bullion, are arranged in line throughout the troughs, about 1.5" apart from the cathodes, consisting of Cu sheets. The troughs are rectangular where the anodes and cathodes are inserted, but below this level, taper to a point in the center at the bottom where a large glass bottle is connected. Temperature of bath is 50° C., and a c. d. of 10 amp./ft.^{2} is used. If much Ag is present, a little HCl is added to the bath. In about a week the electrolysis is stopped and the cathodes are removed. When all suspended matter has separated out, the anode slimes are run into the bottle below. The sediment, plus what Cu liquor is present, is emptied into an earthenware vessel and boiled with a little NaCl, settled, filtered and dried. Its composition varies, but the following is typical: Insoluble, 5%; Pb, 10%; Cu, 6%; Zn, 15%; Fe, 0.4%; Sn, 15%; Ag, 5-20%; Au, 6-15%, and Pt, 0.01-0.6%. The slimes are thrown on to molten Pb in a furnace, the remainder of the process being purely metallurgical. Cost of process quite small. MS (7b)

Studies in Electrolytic Zinc. I. Purification from Nickel (Studi sugli elettroliti per zinco. I. La depurazione dal nichel). L. Cambi & V. Toja with F. Cremascoli. *Giornale di chimica industriale ed applicata,* Vol. 14, Mar. 1932, pages 125-129.
Ni and Co, harmful elements in the deposition of Zn, are found in Monteponi calamines. The ore from Campo-Pisano, for example, carries 20% Zn and 0.005% Ni, in an oxidized form, probably as a silico aluminate, which is soluble in dilute H_2SO_4. The Ni is best removed by precipitation with Zn dust. The precipitation is activated by As, and the activation is more effective in presence of Pb or Hg, i.e., metals of high hydrogen overvoltage. Some hydrogen compound of As is thought to react with the Ni, precipitating a mixture of As and Ni. In treating an impure electrolyte containing in g./L., about 63 Zn, 40 Cd, 0.2 Cl, 0.3 Mn, and in mg./L., about 15 Ni, 21 Co, it was found that adding 3.2 kg. Zn dust and 80g. Na_2AsO_4 per m. of electrolyte, at 50°-80° C. precipitated about 14.5 mg./L. of Ni in 2 hours. Without the arsenate only about 8 mg./L. precipitated in 6 hrs. Ni is more harmful than Co, as Ni in the deposit greatly increases the attack by the electrolyte upon the Zn deposit. Co may be separated by $KMnO_4 + Zn\ (OH)_2$, or by nitroso-beta-napthol. HWG (7b)

The Electrolytic Production of Metallic Antimony from Ores. (Elektrolytische Gewinnung von Metallischem Antimon aus Erzen.) N. A. Isgarischew & S. A. Pletenew. *Zeitschrift für Elektrochemie,* Vol. 37, July 1931, pages 363-365.
An improved process for the cathodic production of electrolytic Sb was developed. By the electrolysis of solutions made of pure chemicals knowledge was obtained which made practical the production of Sb from the leached-out products of Sb ore, forming a thick deposit of the metal on the cathode. The process is continuous; the electrolyte alternately passing through the cell and over the ore is thus constantly regenerated. Arsenic in small amounts in the raw material is not separated with the Sb. Ha (7b)

Recent Developments in Electrolytic Spelter. Arthur Zentner. *Mining Journal,* London, Vol. 177, May 21, 1932, page 342.
The increase in electrolytic Zn annually from 1920 to 1930 is shown. The individual electrolytic plants in the U. S., Canada, Europe, Australia and Africa and their capacities are very briefly considered. The present technical condition of the industry is described. AHE (7b)

Contributions to the Study of Chemical Reactions in Concentrated Electrolytes. The Vanadic Acid Reduction by Means of Hydrogen Bromide and Its Course in Concentrated Electrolyte (Beiträge zum Studium chemischer Reaktionen in konzentriertem Elektrolytmilien. Die Vanadinsäurereduktion mittels Bromwasserstoff und der Verlauf in konzentriertem Elektrolytmilien). M. Bobtelsky & S. Czosner. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 205, May 3, 1932, pages 401-413.
The reduction of vanadic acid by the hydrogen halides was investigated and found that it is a time reaction which becomes measurable only under definite conditions. The applied methods are described and the influences of concentration of the reducing agents on the speed of reaction determined. Ha (7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

The Parker Process for Rust Proofing. O. W. Roskill. *Industrial Chemist,* Vol. 8, Feb. 1932, pages 59-61.

Prevention of corrosion of iron and steel may be divided into two classes: (a) those which depend on covering the surface of the article with a layer of corrosion-resisting material, or (b) formation of a similar layer by chemical interaction of the iron with the reagent employed. Parker process depends on formation of insoluble phosphates on iron surface by using a bath of dihydrogen phosphate of the formula $M(H_2PO_4)_2$, some free phosphoric acid and some ferrous mono-hydrogen phosphate. The metals (M) of the $M(H_2PO_4)_2$ found suitable were Fe, Zn, Mn and Cd; the number of possible metals being limited owing to the facts, first that they must be more electro-positive than iron, and secondly that they must form phosphates similar in nature to ferrous orthophosphate. Methods of preparation of these phosphates are described. A mixture of manganese and ferrous phosphates was found more satisfactory than the use of ferrous salt alone. Optimum ratio of Fe to Mn for maximum rust protection found to be 1:1. Condition of surface to be treated is important factor, pickling and sand blasting being resorted to on smooth surfaces. The chemical action can be accelerated by presence of a small quantity of copper phosphate. The resultant coating forms excellent base for paints, enamels and even for electroplating. The term "Bonderizing" is used when the preliminary accelerated phosphate treatment is applied to act as a base for paints or lacquers. Costs of Parkerizing probably lower than those of any other method of protection of similar efficiency. (8)

The Attack on Mild Steel in Hot Galvanizing. Edward J. Daniels. *Engineering,* Vol. 132, Oct. 9, 1931, pages 479-480.

Condensed from paper read before the Institute of Metals, Zurich, Sept. 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 12. LFM (8)

Surface Coatings for Aluminum Alloys. W. H. Mutchler (U. S. Bureau of Standards). *Metals & Alloys,* Vol. 2, Dec. 1931, pages 324-330.

25 references are cited. The wide use of wrought Al alloys for aircraft construction has led to work on protection against corrosion by sea water. The author reports on 3 types of coatings: oxide, metallic and organic. A film of oxide forming naturally on Al will protect it against ordinary atmospheric corrosion but salt water and spray produce an embrittling corrosion of these light alloys in spite of the naturally formed coating. An oxide protection may be produced of sufficient thickness to protect, by electrolytic methods where the alloy is made an anode in a plating bath until sufficient oxide coating is obtained. Purely chemical means, simple immersion to produce an oxide coating, is not satisfactory. Several methods and baths for carrying out this process are described. Metallic coatings most satisfactorily applied and offering the best protection are Al, Zn and Cd which may be electroplated, applied by metal spraying or alloyed in the metal. The advantages of paints, varnishes, etc., of low cost and ease of application are discussed and compared with their disadvantages of permeability by moisture, mechanical injury and susceptibility to deterioration by sun and weather. Asphalt type paints are most durable and impervious. The variety of types of coating applicable to this problem make for increased possibilities of combinations for decorative or economic reasons. Some such combinations are discussed. WLC (8)

Magnesium Alloy Protection by Selenium and Other Coating Processes. G. D. Bengough & L. Whitby. *Institute of Metals, Advance Copy* No. 587, Apr. 1932, 12 pages.

Coatings suitable for protecting Mg Alloys from salt water corrosion were studied. Mg is readily coated. A coating of Se was found to be effective. It could be applied by immersion of the alloys in a solution of selenious acid, sodium selenite and NaCl. The coatings were tested in a salt-spray apparatus. The Se coating was found to be self-healing. It does not produce an appreciable dimensional change when applied. Additional corrosion resistance can be secured by painting the Se coated alloys; further work is being done towards developing satisfactory paints. The properties of Se are discussed in an appendix. It is concluded that the toxicity of Se compounds has been overestimated. 12 references. JLG (8)

The Determination of the Porosity of Tin Coatings on Steel. D. J. MacNaughtan, S. G. Clarke & J. C. Prytherch. *Iron & Steel Institute, Advance Copy* No. 11, May 1932, 16 pages.

The holes in Sn coatings could be observed by subjecting samples to a hot-water treatment which caused adherent rust to form at each hole. It was necessary to thoroughly clean the samples prior to the hot-water treatment. This was accomplished by swabbing with chloroform or carbon tetrachloride and finally treatment with acetone vapor. Samples were immersed in water just below its boiling point for 6 hrs. The pH of the water should be between 7 and 4.5. The water did not discolor the Sn and apparently caused rust to form at each hole. The compound $FeSn_2$ was not attacked by the water. The ferricyanide tests and various modifications of this test were studied. The addition of small amounts of NaCl causes the blue compound to appear at the pores in the immersion test. When used by applying paper saturated with ferricyanide to the specimen, NaCl also promotes the formation of blue spots. The ferricyanide test was not suitable for testing tinplate that had been cold worked, but the hot-water test was. Illustrations showing the results of the tests on several grades of plate are included. 6 references. JLG (8)

Simple Deposition of Reactive Metals on Noble Metals. A. S. Russell. *Nature,* Vol. 127, Feb. 21, 1931, pages 273-274.

U, Ti, W and Mo are deposited on a Hg surface, as expected according to the Nernst theory of electrode potential, when acidified solutions of their salts are shaken with Hg amalgam. The presence of the very slight concentration of metal is detected by their catalytic effect on the evolution of H_2 from H_2SO_4 solutions by pure Zn. The deposited metals are quite insoluble in Hg. Ha (8)

INDUSTRIAL USES & APPLICATIONS (9)

Some Recent Developments in Welding for the Chemical Industry. F. Leverick. *Welder,* Vol. 3, Jan. 1932, pages 14-18.

With the arrival of stainless and corrosion-proof steels the use of welded steel containers has greatly increased in the chemical industry. 3 types of corrosion occur which affect the welded vessel and therefore the welder: (1) the direct attack on the vessel by the contained liquid, (2) the effect of dissimilar metals in intimate contact, (3) the effect of small holes or pits. Corrosion of the first type cannot be avoided by the welder; the weld should be well built up and undercuts avoided. In the second case, corrosion is caused by one of the metals dissolving in the liquids, the 2 different metals are the stainless steel of the tank and the mild steel of the weld. so that electrolysis can take place. Holes or pits set up corrosion because the liquid in them will soon have a different oxygen content from the rest of the liquid and thus form a small electric cell. The 3 reasons are discussed in detail and their avoidance emphasized. Ha (9)

Aluminum and Its Alloys in Structural Buildings. (Aluminium und seine Legierungen im Bauwesen.) H. Landgrebe. *Bauwelt,* Vol. 22, 1931, pages 957-958.

Examples of large buildings and structures are described. Ha (9)

Mechanical Joints and Pipe Coatings. P. J. Lafore (Boston Consolidated Gas Co.). *Gas Age-Record,* Vol. 68, Oct. 17, 1931, pages 581-582, 585.

The experiences and practices of the Boston Consolidated Gas Co. on pipe joints and coatings are described. VVK (9)

Use of Steel Castings in Welded Structures. J. G. Ritter (Westinghouse Elec. & Mfg. Co.). *American Metal Market,* Vol. 39, Feb. 19, 1932, page 6.

Presented at meeting of Steel Founders Society of America, Chicago, Ill., Jan. 20, 1932. General discussion of economy and improvements. DTR (9)

Alloy Steels in Locomotive Practice. I & II. B. Reed. *Mechanical World & Engineering Record,* Vol. 89, June 12, 1931, pages 562-563; June 26, 1931, pages 606-607.

Deals with various types of Ni steels. Comparison with V steels. WHB (9)

How Wire-Rope Construction Affects Selection. A. S. Rairden. *Engineering News-Record,* Vol. 108, Feb. 25, 1932, pages 287-291.

The manufacture of wire rope is subdivided into 3 main operations: (1) spooling, (2) stranding, and (3) closing. Each of these operations is outlined and discussed. Wire rope types and terms relative to them are defined. A tabulation of the common wire rope types listing them in order of their resistance to wear and giving the common field applications of each type is included. CBJ (9)

Platinum in Electrochemistry (Platin in der Elektrochemie). K. Arndt. *Siebert Festschrift,* 1931, pages 1-11.

Of technical, chemically pure and "physically pure" Pt used as anode in 50% H_2SO_4, the first was the least attacked. This is ascribed to a finer structure due to presence of small amounts of other elements. No information is given as to the actual composition of the material used. HWG (9)

The Heat Treatment and Use of Aluminum Alloys for Aircraft Structures. Robert J. Anderson. *Fuels & Furnaces,* Vol. 9, Nov. 1931, pages 1243-1250.

Al alloys have almost entirely superseded wood and fabric in construction of aircraft, both of the lighter- and heavier-than-air types. Only by suitable heat treatment and aging is it possible for metal alloys to meet the requirements of high strength combined with light weight. Chemical composition and physical properties of the most-used Al alloys are given and discussed. Maximum present attainment for duralumin is represented by tests in Germany on a quenched and air-aged specimen which was further cold-rolled and then aged at about 125° C. The tensile strength was around 64,000 lbs./in.², the yield point 46,000 lbs./in.² with an elongation of over 20%. The Al alloys best adapted to casting or forging are also described together with a discussion of the application of the fabricated alloys to aircraft construction. CMB (9)

Safety of Buildings Constructed with Metallic Frame Work. (La sicurezza delle costruzioni edili con ossatura metallica.) P. Ameri. *La Metallurgia Italiana,* Vol. 24, Feb. 1932, pages 104-110.

General discussion of advantages of steel frame work buildings compared with reinforced concrete. The former are easier to calculate and to test, and even where fire and earthquakes are to be considered, they are preferable. The article is of a qualitative rather than a quantitative nature. HWG (9)

Material for Airplane Construction. (Baustoffrage bei der Konstruktion von Flugzeugen.) P. Brenner. *Die Metallbörse,* Vol. 21, June 27, 1931, page 1206.

Paper before the Wissenschaftliche Gesellschaft für Luftfahrt, May 1931; reviews the progress of Al and Be alloys and CrNi steels employed in aircraft construction with special reference to sea-planes. EF (9)

Use of Aluminum in Architecture and Decorating of Homes. (L'Aluminium dans L'Habitation). Henri d'Auriguy. *Aciers Spéciaux, Métaux et Alliages,* Vol. 6, Aug. 1931, pages 404-414.

A general survey of chemical, physical and mechanical properties of Al alloys. Principal uses of Al alloys in decorating homes. GTM (9)

Metal Best for Walls of Buildings. M. B. Bowman (Bowman Bros., Inc.). *Iron Age,* Vol. 128, Dec. 24, 1931, page 1619.

The advantages of metal walls lie in the great strength obtainable in the small thickness and the weathering qualities of such materials as Al, rustless steel and Cu. 6 all-metal buildings are slated for construction during 1932. VSP (9)

Aluminum and Its Alloys in Navy Construction. (L'Aluminium et ses Alliages dans les Construction Navales.) A. de Biran. *Revue de L'Aluminium,* Vol. 8, Mar.-Apr. 1931, pages 1371-1396.

Historical development and present status of the use of light metals and their different applications and possible savings reviewed; particularly in marine construction. (9)

Alloy Steels in Cracking Equipment. G. Egloff & J. C. Morrell. *Refiner & Natural Gasoline Manufacturer,* Vol. 10, Apr. 1931, pages 77-80.

Cr and Ni steels are chiefly used; others are important, notably those with Cu and Si; the most important parts in cracking equipment are: furnace tubes, headers and plugs, piping and pipe connections. Examples of corrosion are illustrated. WHB (9)

Valves and Valve Steels and Their Heat Treatment. Part II. E. F. Davis. *Fuels & Furnaces,* Vol. 9, Nov. 1931, pages 1259-1264.

Automobile valves are made by forging or extrusion at 1800°-2100° F., or by welding stem to head. The alloy steels used contain Cr from 1.8 to 18%, Si 0.4-4.5%, Ni not over 2.5%, Cu 4-9.5% or Al 1.75-6%. W, V or Mo steels are rarely used in America. Selection of alloy depends largely on whether the valves are to operate below 1000° or at 1400°, 1500° or 1600° F. After forming the valves are annealed at 1400°-1650° F. to improve machinability but further heat treatment is confined to hardening of the stem tips only to give a hardness of C22 to C28 Rockwell. Qualities demanded in the valves are resistance to corrosion, strength, forgeability or weldability, and toughness. CMB (9)

Stainless Steel Car Weighs Less than Seven Tons. *Railway Mechanical Engineer,* Vol. 106, Apr. 1932, pages 137-141.

Detailed construction data of a Diesel electric car of the French Michelin Co. is given; the entire frame of the car is built up of cold pressed and spot welded sections of 18% Cr, 8% Ni stainless steel. The wheels have inflated pneumatic tires at 85 lbs. pressure within the steel tires. The total weight of the car is 13,548 lbs. Ha (9)

Use of Stellite in the Mining Industry. R. A. Elliot. *Canadian Mining Journal,* Vol. 53, Feb. 1932, pages 70-71.

A brief reference to the successful applications and to the possibilities of saving in costs effected by the use of stellite in the industry. The application of stellite by means of the oxy-acetylene torch or the electric arc as hard facing metal is called stelliting and is quite similar to the application of Fe by welding. Successful applications include: clamping dies, shovels, pulverizing hammers, screw conveyors, roaster rabble blades and shafts. Means of application are briefly reviewed. WHB (9)

Cast-Iron Pipe for Columns and Column Cores. *Engineering News-Record,* Vol. 108, June 9, 1932, page 827.

Pipes tested were 4.2" inside diameter and 0.3" thick, with a sectional area of 4.3 in.² The lengths ranged from 42" to 105". The columns tested were: 1. Cast-iron pipe alone. 2. Pipe filled with concrete. 3. Hooped concrete with pipe core. 4. Hooped solid concrete, for comparison. Gravel concrete of of 1:1½; 2¼ mix was used with 6 gal. of water per bag of cement. The columns were 23 days old when tested. Plain cast-iron pipe columns gave ultimate loads ranging from 201,000 to 217,000 lb., concrete-filled pipe 266,500 lb., solid concrete columns 285,000 lbs., and for the cored columns the ultimate loads ranged from 338,000 to 400,000 lbs. CBJ (9)

Mass Production Economies Sought for Small-House Construction. *Engineering News-Record,* Vol. 108, June 2, 1932, page 800; *Brick & Clay Record,* Vol. 80, June 1932, pages 295-296.

American Institute of Steel Construction held small-house forum with discussions by engineers and architects. Steel is a good residence material not only for its strength characteristic but for its ease of fabrication and erection and its ability to serve as a skeleton on which to hang materials. A potential market of 3,600,000 tons annually is available (assuming 300,000 new 6-room houses per year) made up of 2,250,000 tons of shapes in the frame and 1,350,000 tons of sheet and strip in walls, floors, etc., according to the findings of a committee studying this problem. Majority of speakers favor shop fabrication and field assembly. CBJ (9)

Federal Conservatory Uses Aluminum-Alloy Framing. *Engineering News-Record,* Vol. 108, Apr. 14, 1932, pages 539-542.

Al trusses, purlins and glazing bars are used quite extensively in the new conservatory being built for the U. S. Botanic Garden at Washington, D. C. These were adopted mainly to reduce the cost of their maintenance, cleaning, and painting especially in the lofty portions that are difficult of access and are subject to hot moist atmospheric conditions favorable to corrosion. Purlins and ridge chambers were fabricated of 4 S rolled ⅛ H or ¼ H; other shapes, plates, rivets, and bolts, 17 ST; glazing members, 3 S ¼ H; and cast Al 43. CBJ (9)

Bearings for Heavy-Duty Service. *Iron Age,* Vol. 128, Dec. 24, 1931, pages 1633-1635.

Includes discussion. A symposium held in New York at the annual meeting of the American Society of Mechanical Engineers and sponsored by a special research committee on heavy-duty, anti-friction bearings. A brief abstract of 5 papers that were presented is given. VSP (9)

Long-Span Steel Framing in Pittsburgh Building. *Engineering News-Record,* Vol. 108, Apr. 7, 1932, pages 510-512.

New 37 story Gulf Oil building contains no columns in rentable space in the 30 story tower portion. Columns are grouped about elevator and service areas that form the core of the building. Double girders span between these columns and the wall columns. A special three-web built-up column was developed to carry the large column loads. CBJ (9)

Steel-Plate Floor of New Type Installed in Several Buildings. *Engineering News-Record,* Vol. 108, June 23, 1932, pages 889-890.

Floor unit is made of two preformed sheets. The cross section shows 4 keystone-shaped cells formed by a V-shaped bottom element and a U-shaped top element, welded together above the neutral axis. Most units used were 2' wide and 7' 7" long, although heavier units are made 12" wide. Span lengths also vary from 6 to 30'. The floor units to date have been made of pressed-steel sheets but a special rolling-mill is being built for future manufacture. The top and bottom elements are welded by resistance process. After welding each section is dipped in a hot asphalt material to protect against corrosion and serve as a binder and cushioning layer between the steel flooring and the concrete slab, or it receives a baked enamel finish as required by the underwriters, when the cells are utilized as electric conduits. Construction details are discussed. CBJ (9)

Large Uses of Steel in Small Ways. 208th Article. Wheelbarrows. *Steel,* Vol. 90, Jan. 11, 1932, page 30.

The wheelbarrow industry normally consumes 9000 to 10,000 tons of steel annually. In 1930 there were 341,000 wheelbarrows manufactured (all-steel, part-steel, and wood) with an attendant consumption of 8655 tons of steel. JN (9)

Welding on the U. S. Airship Akron. Irving B. Hexter. *Paper read before the 32nd Annual Convention, International Acetylene Association,* Chicago, Nov. 1931, 5 pages.

Data of the U. S. Akron are given and a brief description of where and how welding was applied in the construction. Ha (9)

New Welded Constructions in Steel Structures. (Neue geschweisste Konstruktionen im Stahlbau.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 22, Jan. 31, 1932, pages 61-62.

The article gives a few examples of new types of welded steel constructions. GN (9)

Heat Radiators. (Les Echangeurs Thermiques.) *Revue de l'Aluminium,* Vol. 9, Jan.-Feb. 1932, pages 1643-1649.

Several types of radiators of Al and light metals are described. AH+Ha (9)

Light Metal in Ship Building. (Leichtmetall im Schiffbau.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 22, Mar. 1932, page 155.

A general survey is given on the application of light metal in ship building. GN (9)

Manufacture of Tubes Provided with Ribs and Their Behavior under Thermal Stress. (Herstellung und Verhalten wärmebeanspruchter Flügelrohre.) *Die Röhrenindustrie,* Vol. 24, June 18, 1931, pages 145-147.

The manufacture of tubes with welded-on ribs and their utilization are reviewed. The theoretical factors dominating the temperature course and testing results from measurements up to the present time are communicated. The effects of thermal expansions are pointed out and equipments for measuring the temperature conditions are given. The advantages of employing tubes provided with ribs are summarized with special reference to the efficiency of combustion chambers. EF (9)

Hopper Cars are Built of Aluminum. *Railway Mechanical Engineer,* Vol. 106, Apr. 1932, pages 131, 134.

The detailed construction of 10 hopper cars of 70 ton capacity with bodies of Al alloys is described; the weight of each car is 38,900 lbs.; a saving of 21,200 lbs. was obtained. Ha (9)

Aluminum in the Dairy Industry. (Aluminium in der Milchindustrie). *Schweizerische Technische Zeitschrift,* Vol. 29, Apr. 21, 1932, pages 251-252.

The application in Switzerland of the Al-alloy Anticorodal to milk cans is described. Such cans are seamless pressed out of one piece and then improved by a special aging process. The advantages of Anticorodal for such purposes as contrasted with other materials are outlined. GN (9)

Hard-Facing High-Pressure Valves. *Power,* Vol. 75, Apr. 12, 1932, page 549.

Valves on the duplex boiler feed pumps of a southern company failed regularly after 500 hr. of operation. A thin stellite layer applied by oxyacetylene welding raised the life to 5000 hr. Failure was due to mushrooming of the base metal of the hard-faced disk seat. A harder and tougher base metal and a thicker deposit of the facing material increased their ratio over steel by more than 10 to 1. AHE (9)

Materials in Ships. W. E. Blewett, Jr. *Product Engineering,* Vol. 3, June 1932, pages 229-233.

Speed, capacity, freight-handling facilities and space requirements demand building materials of highest quality in ship building. The average physical properties and chemical composition of some high-elastic steels are tabulated, specifications for castings discussed and the importance of non-ferrous metals illustrated. Ha (9)

Arc-Welded Pipe Line for Gold Mining. R. F. Allen. *Industry & Welding,* Vol. 3, Mar. 1932, pages 2-4, 11.

The total length of the line is 5228' with 40" intake diameter tapering down to 9" at the monitors; the line is welded throughout its length and serves for alluvial gold mining in Columbia. Ha (9)

The Strength of Automobile Tube Frames. (Die Festigkeit von Automobilrahmen.) K. Adloff. *Die Röhrenindustrie,* Vol. 24, Apr. 9, 1931, pages 85-86; Apr. 23, 1931, pages 101-102; May 7, 1931, pages 113-114.

The advantages of a tube frame in comparison with the traditional profile iron frame is explained with the aid of the theory of strength of materials. The vibrations to which the tube frames and the chassis are exposed are outlined and the oscillation strength of the latter are discussed. EF (9)

Metals in the Pantograver. William E. Bailey. *Brass World,* Vol. 28, Apr. 1932, pages 70-71.

An illustrated description of the device used by the Navy Dept. for making engraved Cu plates for printing maps. The pantograver is essentially an improved collapsible parallelogram operating on the pantograph principle. WHB (9)

Architectural Art-Craft and Fusion Welding. (Architekturwerkkunst und die Autogenschweissung.) Jos. Bluemmel. *Die Schmelzschweissung,* Vol. 11, Apr. 1932, pages 75-77.

The possibilities of welding in architectural ornamenting are illustrated by some designs of doors, lattice work, etc. Ha (9)

Tubes in Automobile Construction. (Das Rohr im Automobil.) K. Adloff. *Die Röhrenindustrie,* Vol. 24, Mar. 26, 1931, pages 76-77.

With reference to the recent Automobile Exhibition, Berlin, a new trend in automobile design was noticed insofar as an increasing number of companies incorporated tubes in their models. The salient features involved in the calculation of the frame are reviewed. In favor of the tube frame, the favorable resistance moment of the circumferential cross-section is pointed out and the different frames on the Exhibition are briefly characterized. The writer's remarks on the steels and welding performances are of general nature. The replacement of the front axis by tubes have been carried out by some manufacturers. The further use of tubular parts in automobile bodies is summarized. EF (9)

HEAT TREATMENT (10)

Working and Heat-Treating Steel. (Lavorazione e tempera degli acciai.) A. Massenz. Ulrico Hoepli, Milan, 1931, 5th edition. Cloth, 4¼ x 6 inches, 252 pages. Price 12 lire.

This is a pocket-size shop manual of an elementary nature, chiefly dealing with practical shop methods. Emphasis is laid on methods of quenching small tools to prevent cracking. Very little is said as to working, the volume dealing chiefly with heat-treatment, and including brief comment on carburizing, spark testing, hardness testing, pyrometry, etc.

It is stated that steel is not heat-treatable with less than 0.45% C, so the metallurgy contained has to be taken with a grain of salt. There is no alphabetical index.

H. W. Gillett (10)-B-

Recent Progress in Rail Material. (Les derniers Progres en Matiere de Rails.) Edmond Marcotte. *Revue Générale des Sciences*, Vol. 43, Feb. 15, 1932, pages 81-86.

In reviewing the various means applied for an improvement of rails the heat treatment with a view to obtain a sorbitic structure has proved to be very valuable as it results in a greater economy in the replacing of rails. The sorbite treatment is effected by passing the rail through the furnace in a certain temperature zone. Shoes and bonds should be treated in the same way. Ha (10)

Recent Progress in Heat Treatment of Ball-Bearing Races. Haakon Styri. *Metals & Alloys*, Vol. 3, Feb. 1932, pages 38-39.

The author describes equipment developed for the treatment of ball-bearing races which has resulted in greater elimination of the human element and a more uniform product with improved conditions of working. WLC (10)

Safety of Personnel an Important Factor in Heat Treating. Norman Kyser & R. H. Ferguson. *Steel*, Vol. 90, Jan. 25, 1932, pages 23-25.

A detailed abstract and résumé of a pamphlet on "Safe Practices in Heat Treating," issued by the National Safety Council. The pamphlet discusses the hazards presented to workmen engaged in the various phases of heat treating operations in metal working plants and recommends the safety precautions to be observed in each case. JN (10)

Hardening (10a)

Speculation on Hardening by Electromagnet. Correspondence from W. Rosenhain. *Metal Progress*, Vol. 21, Mar. 1932, pages 71-72.

Calls attention to discrepancies in the research of E. G. Herbert on the electromagnetic hardening of steel.

WLC (10a)

Choice and Hardening of High Speed Tool Steel. (Auswahl und Härtung von Schnellstahl.) W. Schoening. *Maschinenbau*, Vol. 11, Jan. 7, 1932, Pages 12-14.

Compares American and German practice of hardening high speed tool steel. The former takes place at lower temperatures, thus avoiding any decarburization of the surface. Some experiments are reported revealing the strong influence of the quenching and subsequent drawing temperatures and the time of heating on hardness, toughness and surface. Toughness decreases rapidly with higher temperature whereas sufficient hardness with greater toughness will be obtained by longer soaking and lower quenching temperature. Tools soaked for one minute at 1230° C. gave better results than those quenched from 1290° C. without any soaking. For the regular high Cr and W tools the former practice proved best by securing 64 Rockwell C with little decarburization and satisfactory tenacity. It should be preferred to the Rockwell 66 C of the latter method. For proper drawing a temperature of 565°-580° C. is recommended with a 30 minutes' soaking and cooling in furnace or in the open air. Some practical hints are given as to prevention of cracking and distortion. RFV (10a)

Annealing (10b)

Annealing of High Grade Sheet Metal. (Die Glühung von Qualitätsfeinblechen). E. Marke. *Stahl und Eisen*, Vol. 52, Mar. 17, 1932, pages 262-266.

Annealing in open fire, pot, continuous and normalizing furnaces all given in detail as to temperature, furnace size and construction, fuel used, cooling, etc. Distinction is made between ordinary and "normal" annealing; in latter method temperature is brought appreciably above Ac_3 point, followed by period of rapid cooling, and finally slow cooling. Disadvantages of continuous furnace annealing compared with annealing in single or double pot furnace are: 1. Hot gases on both sides do not uniformly surround pots. Carriage and lower section of pot absorb great part of heat, and annealing in various parts of pot is not uniform. 2. Furnace cannot always be charged uniformly with same high grade material. 3. Slow cooling often produces large crystal grains, restricting physical properties, which is not desirable. Each pot, in a single pot furnace, undergoes its special heat treatment, with rather rapid cooling, permitting pot to be withdrawn from furnace while at red heat. Flame uniformly surrounds pot in pot furnace. Advantages of continuous furnace over pot furnace are: 1. Fewer pots used up. 2. Less fuel used. Advantages of "normal" annealing over all other methods are: 1. Finished sheet is exceptionally uniform in physical properties and structure, permitting highest deep drawing work. 2. Normalizing may be carried out conveniently and safely, even with larger sheets. 3. No pots needed. 4. No danger of sheets sticking, which is great in pot and continues furnace annealing. 5. More tonnage can be annealed in a few hours in normalizing furnace than can be annealed in several days in pots. Following classes of sheets should be normalized: 1. All sheets annealed only once, that must possess highest deep drawing qualities. 2. For specially clean surface sheets, in addition to having good deep drawing qualities, they should be normalized, pickled, cold rolled and pot annealed. 3. In many sheet mills for greatest security in obtaining sheets of high quality, "normal" annealing is used for final anneal. Structure of a normalized sheet is shown, containing 0.1% C, Erichsen 11.7 mm., Rockwell 54, T.S. 32.4 kg./mm², elongation 40.5% on 50 mm. length. DTR (10b)

Annealing of Copper Wire (Ricottura dei fili capillari di rame). O. Gamalfro. *La Metallurgia Italiana*, Vol. 24, Apr. 1932, pages 292-294.

The author claims that bright annealing of Cu wire can be accomplished by using a closed cast iron container, packed full of coils of wire so as to leave but a small air space. The oxygen of the air is alleged to be absorbed by the cast iron at 300° C. or above, 400° C. being the operating temperature. Laboratory tests on passing a measured volume of air over gray iron at 400° C. (composition of the iron and whether it was in turnings or in solid pieces not stated) are said to show the bulk of the oxygen to be used in oxidizing the iron, without formation of CO. The cast iron is oxidized as a whole. The presence of graphitic C is not harmful. Iron containers other than cast iron work all right on the first heat, but lose their ability to take up oxygen thereafter. Al acts in similar fashion. The porosity of cast iron avoids such a phenomenon in its use. No data are given on the life of the cast iron container. The statements made appear to be based primarily on laboratory tests, and do not carry conviction to the abstractor. In a closed container the residual oil on the wire is usually sufficient to produce a bright anneal if air is excluded during cooling so that the container may work all right without requiring the explanation as to preferential oxidation of cast iron. HWG (10b)

Case Hardening & Nitrogen Hardening (10c)

Recent Investigations of the Case Hardening of Locomotive Slide Bars (Neue Untersuchungen auf dem Gebiete der Einsatzhärtung von Lokomotiv-Gleitbahnen). Hellmut Cramer. Doctor's Thesis, Technische Hochschule, Hannover.

See *Metals & Alloys*, Vol. 2, Dec. 1931, page 309. (10c)

Development of Continuous Gas Carburizing. R. J. Cowan. *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1113-1117.

Paper read before the Iron & Steel Division of the American Institute of Mining & Metallurgical Engineers, Sept. 25, 1931. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 309. MS (10c)

The Present Position of the Nitriding of Metallurgical Products. (L'Etat actuel de la Nitruration.) L. Guillet. *Genie Civil*, Vol. 98, May 16, 1931, pages 489-495.

The developments of the subject are treated under the headings of (1) steels for nitriding, (2) the operation and control of the nitriding process and (3) the properties of nitrided steels and their applications. The very comprehensive test results are reproduced in diagrams and microphotographs, and the results of practical operations for various industries are tabulated. Ha (10c)

Quenching (10d)

Effect of Moisture in Salt Baths for Steel Treating. Bernard Thomas. *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1111-1112.

Irregular results obtained in quenching in newly made salt baths or those which had stood for a time without work indicated that moisture was the cause of the breakages. Although equal hardness could be obtained in two pieces of plate, one of which had been quenched in H_2O and the other in a salt bath, the former had needles of martensite which were much larger than those obtained in the latter. These large needles would tend to increase brittleness. Tests were then made by adding H_2O to salt baths known to be giving good results. Addition of only 1 part H_2O to a bath containing several cwt. of salt produced brittleness. The effects increased with addition of definite amounts of H_2O until a stage was reached where the results obtained were little better than those from an ordinary H_2O quench. The effects were felt up to a temperature of about 700° F. at which temperature the salt appeared to boil for about an hour. After this boiling, results obtained on quenching would again be satisfactory at any working temperature possible with the particular salt employed. This indicates that in order to be sure that a bath is free from moisture it should be heated to 700° F. and held there. MS (10d)

Sorbitization of Rails at Petrowsky Works. W. I. Malyi. *Domez.* (Achievements of Metallurgy in USSR and Abroad), No. 9, 1931, pages 34-60. (In Russian.)

Bessemer rails were quenched directly from the hot bed in water and were drawn by the heat still remaining in the metal. An automatic quenching jig received 12 m. rails, held them so as to prevent any distortion and immersed their heads in a water tank for about 30 sec. Full description of the quenching arrangement is given. Brinell, impact and tensile testing demonstrated that sorbitization of the head of the rail was quite uniform, though physical properties were somewhat spotty. On an average, impact values increased considerably while hardness and stiffness increased also. Altogether 82 rails were treated. (10d)

Drawing (10e)

On the Drawing Effects in Quenched Aluminum-Copper Alloys. (Ueber die Anlasswirkung von abgeschreckten Aluminium-Kupferlegierungen.) W. Stenzel. *Die Metallbörse*, Vol. 21, July 18, 1931, page 1350.

The paper before the Kaiser Wilhelm Gesellschaft für Metallforschung, 1931, mainly refers to investigations of von Goeler & Sachs, Hengstenberg & Wassermann, Dix & Richardson in addition to the speaker's own research work. The precipitation consists of four phenomena. The conversion of the homogeneous solid solution into a heterogeneous mixture takes place in 3 stages. EF (10e)

Aging (10f)

Properties of Locomotive Tires Change with Age. Correspondence from A. A. Stevenson (Ardmore, Pa.) *Metal Progress*, Vol. 20, Dec. 1931, pages 81-82.

The writer reports variations noted at the Standard Steel Works in 1898 in tensile tests on locomotive tires that can be explained as due to an aging effect. Data is given showing differences due to waiting a few days or a few weeks after the tire was made before testing. WLC (10f)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

Arc-Welded Factory Building in Canada. *Engineer,* Vol. 152, Dec. 11, 1931, pages 617-618.

Illustrated article describing the erection of the new switchboard building of the Canadian General Electric Company at Peterborough, Ontario, the first all-welded building of any size in Canada. The lowest breaking stress obtained by welder working on this building was 12,250 lb. per linear inch for ⅜" by ⅜" fillets. In periodical field tests made on tension test pieces only, an average tensile strength of between 53,000 and 54,000 lb./in.^{2} was obtained. In several cases the break occurred in the parent metal rather than in the weld. LFM (11c)

Outstanding Welding Developments in 1931. Compiled by the Meetings and Papers Committee of the Welding Society. *Sheet Metal Industries,* Vol. 5, Feb. 1932, pages 723-724, 727-728.

Generalities on the growth of the welding field are set forth and new types of welding and cutting apparatus are discussed AWM (11c)

Outstanding Welding Developments in 1931. Compiled by the Meetings and Papers Committee of the American Welding Society *Journal American Welding Society,* Vol. 11, Jan. 1932, pages 5-9.

The outstanding feature in the development of welding in 1931 was the presentation of the Structural Steel Welding Committee Report epitomizing a 5 years' program of study and tests of various types of welded joints. Developments in the following fields are also cited: Structural Steel Welding and Cutting, Pressure Vessels and Boilers, Pipe Lines, Machinery Construction, Tanks, Automotive Industries, Hard Facing, Plumbing, Heating and Steam Fitting, Railroad Welding, Marine Welding, Gas Cutting, Welding and Cutting Apparatus and Welding Wire. TEJ (11c)

Largest Welded Steel Bridge. Technical Publicity Dept. of the Skoda Works, Pilzen. *Journal American Welding Society,* Vol. 11, Jan. 1932, pages 27-28.

The largest fully welded trestle bridge in the world has a span of 161 ft. 5 in., width 27 ft. 5 in., surface in plan 4413 ft.^{2}, weight 143 tons. The bridge was designed and constructed by the Skoda Works and it connects the north and south parts of the Skoda Works in Pizen, Czechoslovakia. The article includes a list of other all-welded structures. TEJ (11c)

Fundamental Research Problems on Welding. Compiled by the American Bureau of Welding. *Journal American Welding Society,* Vol. 11, Feb. 1932, pages 5-7.

A list of 50 fundamental research problems in welding which need investigation. The problems are divided into the following groups: (A) Investigations involving physical tests, (B) Involving considerable metallurgical experience, (C) Problems in physics, (D) Problems involving welding procedure, (E) Structural studies, (F) Problems involving chemistry, (G) Psychological. TEJ (11c)

Report of the Oxy-Acetylene Committee. *Paper presented at the Annual Convention, International Acetylene Association,* Chicago, Nov. 1931.

The progress made in the year 1931 in methods, equipment, and products, research, educational and promotional activities and some other uses of oxygen and acetylene are exhaustively reviewed. Ha (11c)

Welded Connections Pass Rigid Tests. *Gas Age-Record,* Vol. 68, Dec. 19, 1931, page 881.

Expansion joints and the welds of the electric welded 22" Panhandle-Eastern pipe line were given spring tests and 800 lb. pressure tests with satisfactory results. VVK (11c)

Carbon Arc Welding. A. Y. Stirrat. *Welding Journal,* Vol. 28, Dec. 1931, pages 378-380; Vol. 29, Jan. 1932, pages 14-15.

Paper read before the members of the North-Western Branch of the Institution of Welding Engineers, Nov. 1931. Part I. In this portion of his paper, the author gives detailed procedure for carbon arc welding. It is very important that welders are well trained. Graphitic carbons, ½" to ¾" in diameter are used, with currents ranging from 400 to over 1000 amperes. Arc lengths from 1½" to 3" are employed. Welds are made in the horizontal position and are well hammered. Strength of carbon arc welds is satisfactory but ductility is low. Difficulty is encountered in controlling the arc blow. The author believes that the use of carbon arc welding will gradually decrease. Part II. Following a quite complete historical outline of the development of the carbon arc welding process, the author discusses proper technique for good carbon arc welding. A long arc, kept in constant motion, is essential. TEJ (11c)

Non-Destructive Testing of Welds. *Canadian Engineer,* Vol. 62, Feb. 2, 1932, pages 17-18, 52.

Non-destructive tests for welds consist of hydrostatic, air pressure, reheating with a blowpipe, the stethoscope and the X-ray. These are briefly described. VVK (11c)

A New Type of Steel Floor. Joseph G. Shryock. *Journal American Welding Society,* Vol. 11, Feb. 1932, pages 11-12.

A report of loading tests on 3 full-size floor panels. Panels made of light weight stair channels interlocked. Different methods of attaching the members to each other were used in each case, namely—bolts, rivets and tack welds. With safe working loads, all three types of construction were entirely satisfactory, but under overloading, both uniform and concentrated, the welded panel was much stiffer than either the riveted or the bolted panels. TEJ (11c)

Some Details of Welding in Boilerworks' Practice. E. W. Thompson & A. Jeavons. *Welding Journal,* Vol. 28, Dec. 1931, pages 366-370, 383; Vol. 29, Jan. 1932, pages 6-10.

Paper read before members of the Institute of Welding Engineers at Birmingham, Nov. 1931. Includes discussion. The authors review the development of welding processes as used in the manufacture of pressure vessels. Details of the hydraulic roller water-gas welding process are given. The authors believe that one of the most important points in producing a satisfactory welded vessel is correct heat treatment. Much progress will have to be made in electric welding before it can be used safely for high pressure vessels. Experiments show that ⅜" to ⅝" electrode with currents from 450 to 1000 amperes will be used, depositing metal at probably 50 lbs./hr. Tests show that the single Vee joint is better than the double Vee. TEJ (11c)

Arc Welding Brings Strength and Economy to Residence Building. J. F. Lincoln. *Welding*, Vol. 3, Feb. 1932, pages 92-95.

A description of arc welded steel frame house of practical design, the type of construction of which it is predicted will eventually become universal. This construction has many advantages over the conventional wood framing, the cost being approximately the same. 12 illustrations show the design and method of construction. TEJ (11c)

Equation for the Calculation of the Operating Costs of an Arc-Welding Shop. (Une formule pour le calcul des frais d'exploitation d'un atelier de soudure a l'arc.) Paul Neumayer. (Société Siemens-France.) *Revue Générale de l'Electricité*, Vol. 31, Jan. 23, 1932, pages 127-131.

Develops an equation for calculation of operating costs. By means of this equation, author compares two systems; (1) direct-current converter set and bare electrodes, and (2) transformer and coated electrodes. Discusses the influence of the various factors in the equation on operating costs. Favors the use of the first system. MS (11c)

The Advance of Electric Arc Welding. Edward Dacre Lacy. *Metallurgia*, Vol. 5, Apr. 1932, pages 209-210.

Reports some recent English applications. JLG (11c)

Industrial Concerns in England Advocate Welding. E. Dacre Lacy. *Welding*, Vol. 3, Feb. 1932, pages 99-102.

The author, having recently visited a number of manufacturing concerns in various parts of England, tells how equipment for chemical, gas, cement and ship building industries are fabricated by welding. Illustrated. TEJ (11c)

Electric Welding (La soudure électrique). Part I, II. Mathieu. *L'Industrie Électrique*, Vol. 40, Nov. 25, 1931, pages 523-527; Dec. 10, 1931, pages 548-551.

Reprinted from *Bulletin de la Société Française des électriciens*, Series 5, Vol. 1, Aug. 1931, pages 810-845. These parts deal with power supply of single-phase, d.c., and 2-phase welding apparatus, various processes of electric welding and resistance welding machines. MS (11c)

On the Effectiveness of Electro-Welded Reinforcements of Railroad Bridges. (Über die Wirksamkeit ausgeführter Verstärkungen von Eisenbahnbrücken durch Elektroschweissung.) R. Bernhard. *Die Elektroschweissung*, Vol. 3, Jan. 1932, pages 1-10.

The paper reports the results of investigations on the electro-welded reinforcements of 3 railroad bridges of the German Federal Railroad System. The extensions measured in the welded seams confirm that the seams participate in any movement of the parts adjacent to the seam. Permanent stresses could not be observed in the seams. X-ray examinations show the seams to be perfectly sound. GN (11c)

Specifications for Welding Piping for High Temperature and High Pressure Steam Service. F. W. Martin. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 7 pages; *Journal American Welding Society*, Vol. 11, Feb. 1932, pages 24-27.

Steam pressures of 1200 lbs. to 1400 lbs. are in use in many power stations with temperatures of 750° F. to 850° F. The very highest type of welded work is necessary for steam pipe operating under these conditions. A specification for welding must first require that the welder is competent to make first class welds and that he is of a mental and moral character to be entrusted with work of great responsibility. Second, it must inform the workman as to what kind of work is required in such terms that there will be a minimum of misunderstanding and errors in interpretation; and third, it must provide for supervision and inspection to insure that the finished work is as called for in the specification and will fulfill the requirements desired. These requirements are discussed by the author. See also "Metallurgical Requirements for High Temperature Piping," *Metals & Alloys*, Vol. 2, Oct. 1931, page 232. Ha+TEJ (11c)

The Influence of Current in Arc-Welding Soft Steel. F. Lefring. *Journal American Welding Society*, Vol. 11, Feb. 1932, pages 7-8.

Description of extensive welding tests carried out with A.C. as well as D.C. with either polarity at various current intensities on different thicknesses of metal. See *Metals & Alloys*, Vol. 2, Feb. 1931, page 41. TEJ (11c)

Welding Reinforcing for Concrete Pipe. Jos. C. Coyle. *Welder*, Vol. 3, Jan. 1932, pages 19-23.

Two water lines using 60" pipe are described; pipes are welded in the field from sheets cut to size; each 12 ft. section weighs 7 tons. Ha (11c)

Arc Welding in Mercantile Shipbuilding. Provisions of the German Lloyd regarding the Use of Electric Welding in Ships. (Lichtbogenschweissung im Handelsschiffbau; Bestimmungen des Germanischen Lloyd über die Anwendung der elektrischen Schweissung auf Schiffen.) G. Buchsbaum. *Zeitschrift Verein deutscher Ingenieure*, Vol. 75, Sept. 26, 1931, pages 1229-1230.

A historical sketch of the development of arc-welding in shipbuilding and a discussion of the instructions issued for electric arc welding of vessels. Ha (11c)

Arc Welding Large Cast Iron Pots. Ernest Bauer. *Welding*, Vol. 3, Feb. 1932, pages 95-96.

The author tells how cracked cast iron pots, 10 ft. in height, 10 ft. inside diameter, having a wall thickness of 2" to 3", are being successfully repaired by metallic arc welding. See also *Metals & Alloys*, Vol. 3, Apr. 1932, page MA 99. TEJ (11c)

The Stress Distributions in Fusion Joints. E. G. Coker & R. Lavi. *Proceedings Institution of Mechanical Engineers*, Vol. 120, May 1931, pages 569-602.

Includes discussion. Rather theoretical discussion of stresses in the more elementary forms of welded joints. All joints so far as workmanship is concerned were assumed to be perfect. RHP (11c)

All-Welded Hospital Building Erected at Boston. Anthony S. Coombs. *Welding*, Vol. 3, Mar. 1932, pages 147-149.

The author describes the erection of the first shop and field welded municipal structure in Boston. Includes design details, inspection and qualification of welders. The building required 492 tons of steel. TEJ (11c)

Phases of Gas Welding. Glenn O. Carter. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 4 pages.

A diagram, or chart of nomenclature is laid out for the various methods of welding; gas welding, with oxy-acetylene being subdivided according to the nature of the flame, i.e. according to whether there is an excess of oxygen, a neutral flame, or an excess of acetylene. The different points are discussed. Ha (11c)

Welding Allegheny Metal. G. van Dyke. *Machinery*, Vol. 75, July 1931, pages 875-876.

See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 72. Ha (11c)

Automatic Arc-Welding Applications. A. M. Candy. (Westinghouse Electric & Mfg. Co.) *Machinery*, Vol. 38, Dec. 1931, pages 270-272.

Presents methods of applying automatic welding to several operations, including, car wheels, well casing tanks, etc. Machines used are made by Westinghouse. RHP (11c)

When a Bridge Becomes Old. L. R. Canfield. *Journal American Welding Society*. Vol. 11, Feb. 1932, pages 29-30.

An interesting description of the reinforcement of floor and superstructure of a 31 year old bridge by use of arc welding. TEJ (11c)

Discussion of Paper on "Maximum Stress; its Influence on Cost and Service Life of a Structure" by Everett Chapman. *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 19-22.

Discussion of Paper presented at Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 19-22. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 306. TEJ (11c)

Resistance Welding, What it is and What it does. M. L. Eckmann. *Industry & Welding*, Vol. 3, Feb. 1932, pages 15-20.

The author classifies resistance welding as (1) flash welding and butt welding, (2) spot welding and projection welding, (3) seam welding and line welding. The 3 classes are discussed and the method of their operation described. Ha (11c)

Procedure for Welding High Manganese Steel Frogs and Crossings. A. F. Davis (Lincoln Electric Co.) *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 51-52.

Instructions for reclaiming worn frogs and crossings of 12% Mn steel. TEJ (11c)

Gas Welding in the Automotive Industries. R. E. Esch. *Industry & Welding*, Vol. 3, Feb. 1932, pages 22-27.

The application of oxy-acetylene welding for the different stages in automobile manufacture is described. Ha (11c)

Variations in Battledeck Floor Construction. A. F. Davis. *Journal American Welding Society*, Vol. 11, Jan. 1932, pages 31-32.

The author describes procedure used in the construction of a welded battledeck flooring for a 100 ft. by 50 ft. three story building. A wood floor may be laid over the steel plate by the use of 2" by 4" wood sleepers which are fastened to the steel plate by means of a special threaded nail. The floor is then nailed to the sleepers. TEJ (11c)

Safety Feature in Oxygen Regulator Construction. Earl M. Eveleth (Bastian Blessing Co.). *Welding*, Vol. 3, Jan. 1932, pages 20-21.

Discussion of some of the potential hazards present in the regulation of high pressure oxygen and methods used by the regulator engineer in minimizing these hazards. TEJ (11c)

Production Gas Welding of Sheet Steel Cylinders. Earl Eveleth (Bastian-Blessing Co.). *Iron Age*, Vol. 128, Sept. 3, 1931, page 634.

Discusses the fabrication of a refrigerant liquid receiver. It is a 14-gage steel cylinder, 4" in diameter and 10" long, made from 2 cup-shaped halves, joined at the center girth seam by welding. Results, over a period of mos., show that actual production of finished welds averages 45 pieces an hr. with a gas consumption of 0.53 ft.^{3}, each, of oxygen and acetylene per piece. VSP (11c)

Reduction of Manual Processes in the Manufacture of Milk Transport Cans by Acetylene Welding. (Verminderung der Arbeitsgänge bei der Fabrikation von Milchtransportkannen durch Azetylenschweissung.) W. Greiner. *Autogene Metallbearbeitung*, Vol. 25, Feb. 1, 1932, pages 38-40.

Detailed description of the cutting of sheets and welding of parts. Ha (11c)

Welding Field Storage Tanks. Edw. E. Dillman. *Industry & Welding*, Vol. 3, Feb. 1932, pages 8-11.

Describes a lap joint and a butt-strap joint for storage tanks with automatic welding machines. See *Metals & Alloys*, Vol. 3, Apr. 1932, page MA 100. Ha (11c)

Control of Welded Seams by the magnetographic Method. (Controle des soudures par la methode magnetographic.) C. Franche. *l'Électricien*, Vol. 63, Feb. 15, 1932, pages 81-83.

There has always been difficulty in controlling the condition of a welded seam. The following method is a simple and effective test method to determine the condition of the weld. An electromagnet is placed across the seam and a piece of paper over the seam between the poles of the magnet. Iron filings are spread over the paper. The magnetic lines clearly indicate whether the seam is continuous or interrupted by flaws or contains irregularities of any kind. WR (11c)

Gas Welding Opportunities under the Revised A.S.M.E. Boiler Code. Chas. E. Gorton. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 5 pages, Mimeographed.

The work done by the Boiler Code Committee since 1911 is reviewed; the newest 1931 edition does not place any objection in the way of using fusion welding methods for pressure vessels as long as they fulfill the requirements as to quality of weld. Ha (11c)

A Large Welded Steel Tank. (Ein geschweisster Stahlgrossbehälter.) E. Gentilomo. *Montanistische Rundschau, Stahlbautechnik*, Vol. 23, Aug. 16, 1931, pages 65-68.

Arc welding was employed for the erection of a tank in sugar industry. The peculiar conditions of the erecting place, tests on seams of welded samples involving differently shaped seams and water pressure tests on the completed tank are described at length. EF (11c)

Building up Worn Shafts by Arc-Welding. H. E. HERMANN. *Machinery*, Vol. 38, Nov. 1931, page 204.

The shaft of a tire welding machine was built up by welding when it was impossible to shut down long enough to replace the shaft. Metal was welded on to a depth of 3/16". RHP (11c)

Oscillator Stabilizes A. C. Welding Arc. J. B. GIBB. *Electrical World*, Vol. 99, Feb. 27, 1932, page 405.

Addition of a high-frequency oscillation circuit in parallel with the secondary of a welding transformer eliminates most of the obstacles that have prevented a.c. welding from competing favorably with d.c. welding. It avoids the necessity of a high open-circuit voltage in the secondary of the welding transformer to re-establish the arc when it is interrupted. A compact portable a.c. welder is illustrated. WHB (11c)

A Self-Stabilizing D.C. Welding Generator. K. L. HANSEN. *Electrical Engineering*, Vol. 51, Feb. 1932, pages 108-111.

A new machine is briefly described and illustrated that requires no external reactor, but employs a special field winding to compensate for resistance fluctuations in the welding circuit. The machine is completely self-contained and self-excited. Shifting of brushes permits very fine adjustments of current. Features claimed for the machine are (1) the external reactor has been eliminated, (2) current impulses in the main circuit are reflected into the generator field to quicken magnetic flux changes, (3) the exciter has been eliminated without resorting to a 2-pole armature and four-pole field structure, (4) all regulating rheostats and switches have been eliminated without limiting the range or adjustment of welding currents, and (5) desirable arc characteristics are obtained over the whole range. WHB (11c)

Welding of Nickel and its Alloys. (Zur Frage der Schweissung von Nickel und seinen Legierungen.) HANS A. HORN & W. GELDBACH. *Schmelzschweissung*, Vol. 11, Jan. 1932, pages 5-11; Feb. 1932, pages 40-43.

It is shown under which conditions and by which means sound and technologically good welds with Ni and its alloys could be made. Pure Ni, Mn-Ni alloys, Cu-Ni alloys cast and rolled (70% Cu, 30% Ni), and "Nicorro," an alloy of 67% Ni, 33% Cu, and German silver were investigated. Fluxes, welding rods and gas and electric welding methods were tested with regard to quality of the weld. The microstructure of all welds was taken and the physical properties for each individual test are tabulated. For details the paper must be referred to. Ha (11c)

Discussion of Paper on "Automatic Gas Cutting" by R. F. HELMKAMP. *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 11-12.

Discussion of Paper presented at Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 36-38. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 17. TEJ (11c)

Allegheny Metal in Dairy Equipment. L. W. HOSTETTLER. *Journal American Welding Society*, Vol. 11, Jan. 1932, pages 25-26.

Extracts from an address presented at the National Dairy Exposition, Atlantic City, Oct. 22, 1931. The author gives detailed procedure for oxy-acetylene and arc welding of 18% Cr—8% Ni steels such as Allegheny Metal. Resistance welding of this material is also mentioned. Weld decay and carbide precipitation are discussed. TEJ (11c)

Fundamental Data Pertaining to Resistance Welding. G. A. HUGHES. *Welding*, Vol. 3, Feb. 1932, pages 84-87; Mar. 1932, pages 154-156.

The author describes the principles of various resistance welding processes and the important factors affecting the spot welding process. By some one of the resistance welding methods, nearly all metals and alloys can now be welded. Steel plates over ¾" thick have been spot welded. Current used was 100,000 amperes and pressure 40 tons. The pressure required varies with the thickness of the work, chemical properties of the material and current used. Power factor on single spot welding machines ranges from .35 to .50. Tests show that where several spot welders are connected to operate from a single transformer, its kwa. capacity should be about 66% of the total rated kwa. of the welders. Copper electrodes give the best results. Chemical analysis of weldmetal shows it to be practically the same as the unwelded low carbon steel. For ideal spot welding conditions, the plate should be very close to the following analysis: C 0.25% or less, Mn 0.40-0.80%, P .025% max., S .025% max., Si low as possible. Part II. The four variables to be considered in resistance welding are: (1) the voltage across the electrodes, which is usually between 4 and 14 volts, (2) electrical resistance at the joint, (3) pressure of the electrodes, (4) current. Tests on open hearth steel of less than .40% C content show that average strength of resistance welds is 93% of strength of parent metal. The author discusses design of butt welding machines, efficiency of resistance welders, strength of welds and the testing of a resistance welded bar joist. TEJ (11c)

Welding in Structural Steel Work. (Die Schweissung im Stahlbau.) A. HILPERT (Technische Hochschule Berlin). *Montanistische Rundschau*, Vol. 23, Nov. 16, 1931, pages 89-93.

The rapid progress in the adoption of welding in structural work during the last 1½ years is reviewed. The legal enactments during this period of time are briefly considered, the advantages in comparison with riveting are summarized and the scope of welding is clearly shown in 13 representative illustrations. Paper at the Deutsche Bauaustellung, Berlin, 1931. See also *Metals & Alloys*, Vol. 2, Dec. 1931, page 307. EF (11c)

The Application of the Oxy-Acetylene Process in the Production of Motor Cars. R. E. ESCH. *Journal American Welding Society*, Vol. 11, Jan. 1932, pages 23-25; *Paper presented to the 32nd Annual Convention of the International Acetylene Association*, Chicago, Nov. 1931, 6 pages.

The oxy-acetylene welding process has a well established field in the automobile industry. The author describes various applications of this process in the manufacture of automobile bodies and other parts. In construction and maintenance work in connection with plant equipment, the oxy-acetylene process, both for welding and cutting, is almost indispensable. Ha + TEJ (11c)

Relief of Welding Strains by Annealing. CHARLES H. JENNINGS (Westinghouse Elec. & Mfg. Co.). *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 26-29; abstracted *American Machinist*, Vol. 75, Nov. 1931, page 766; discussed *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 24-26.

Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. A "soaking time-stress curve" chart is included. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 310. RHP + TEJ (11c)

A Sign of Progressive Manufacturing. I. C. JONES. *Journal American Welding Society*, Vol. 11, Feb. 1932, page 27.

Description of fabrication of a large electrically illuminated sign which was fabricated from 20 gage sheet steel by means of the oxy-acetylene welding process. Advantages of this method of fabrication are discussed. TEJ (11c)

Permanence for Roofs. OWEN C. JONES (Linde Air Products Co.) *Journal American Welding Society*, Vol. 2, Dec. 1931, pages 50-51.

Various building projects are described to illustrate the adaptability of the welding blowpipe for Al roofing installations. TEJ (11c)

Shrinkage Strains in Butt Welded Joints. C. H. JENNINGS. *Welding*, Vol. 3, Feb. 1932, pages 119-122.

Rigid 1½" butt joints of the 60° double vee type were arc welded with 5/32" bare mild steel electrode. Six types of welding procedure, varying in the method of depositing the weld metal and the application of peening in certain cases, were investigated. By taking strain gage measurements on each specimen before and after welding, data were obtained on which the author based the following conclusions: (1) There is very little difference between the shrinkage strains as obtained by the cross weave procedure and the horizontal layer procedure. (2) Smaller shrinkage strains were obtained by the vertical layer procedure than by the cross weave, horizontal layer and vertical weave procedures. (3) The vertical weave procedure developed the greatest shrinkage strains. (4) The peened horizontal layer procedure developed smaller shrinkage strains than the cross weave, the horizontal layer, the vertical layer and the vertical weave procedures. (5) The peened vertical layer method produced the smallest shrinkage strains. (6) Peening is very effective as a means of reducing shrinkage strains in butt welds. (7) Stresses in butt welds are not evenly distributed along the joint. The exact stress distribution depends upon the rigidity of the joint and the method of welding. (8) Peening is very effective in producing a uniform stress distribution in butt welded joints. TEJ (11c)

Welding—The Engineer can Make it or Break it. R. KRAUS. *Product Engineering*, Vol. 3, Jan. 1932, pages 29-31; Feb. 1932, pages 77-78.

The success of welded designs depends greatly on the preparation, amount of welding, handling and accessibility of joints; these 3 factors are discussed from the point of view of using the metal to best advantage. Sketches show how welds should be arranged to avoid shrinkage stresses. It is the task of the designing engineer to take these points into account when laying out a welded piece. The correct and wrong way in using fillet welds is illustrated by examples in order to eliminate excessive welding and handling, increasing accessibility and speeding assembly. Ha (11c)

The Welding Engineer. (Der Schweissingenieur.) E. KALISCH. *Schmelzschweissung*, Vol. 11, Feb. 1932, pages 25-27.

The necessity of expert supervision of welding processes by properly educated or trained men is pointed out and the opportunities described which are offered in Germany for this purpose. The question is discussed whether this training should be simply directed towards producing an expert in welding or if also this curriculum of 13 weeks should give broader education in engineering; this is answered in the negative as these schools shall preferably train in practical ways. Ha (11c)

The New Keel Multi-Flame Blowpipe. C. F. KEEL. *Journal American Welding Society*, Vol. 11, Feb. 1932, pages 16-19.

Article from the Swiss *Journal de la Soudure*. Reprinted from the *Welding Journal*, Vol. 28, May, 1931. Author gives a description of an interesting and important innovation in oxy-acetylene welding, namely the so-called multi-flame blowpipe by the use of which it is claimed, the speed of welding can be increased 50 to 60% and the cost reduced 25 to 30%. The blowpipe and its operation are described and its various advantages over the single-flame blowpipe are discussed. TEJ (11c)

Discussion of Paper on "The Future of Welded Ship Construction" by J. KJEKSTAD. *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 12-14.

Discussion of Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in *Journal American Welding Society*, Vol. 10, Sept. 1931, pages 13-16. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 310. TEJ (11c)

Stress Distribution in Welded Joints. (Die Spannungsverteilung in Schweissungen.) W. HOVGAARDT. *Zeitschrift für angewandte Mathematik und Mechanik*, Vol. 11, Oct. 1931, pages 341-348.

A mathematical treatment of (a) reinforcement and stiffeners and (b) lap welded joints. The formula derived by the writer is fully substantiated by previous experiments of Hammond Smith (*Journal American Welding Society*, Vol. 8, Sept. 1929) concerning lap-welded joints. EF (11c)

Riveting (11d)

An Investigation of Duralumin Rivets. I. G. SHOULGIN. *Central Aero-Hydrodynamical Institute*, No. 81, May 1931, 80 pages, 83 figures. (In Russian)

Several thousand mechanical tests of riveted joints indicate that for general work rivets of duralumin containing 2.5-3.5% Cu aged 7 days in air after quenching in water at 500° C. are the best. They have 21.5-23 kgs./mm.^{2} strength aged in driven condition and 24.5-26.3 kgs./mm.^{2} in undeformed state. Duralumin containing 2% Cu is too soft (20.5 kg./mm.^{2} and 22.5 kg./mm.^{2}) while the alloys containing 3.6-5% Cu are difficult to drive. They have 23.5-25.5 kgs./mm.^{2} and 26.5-28.5 kgs./mm.^{2} for tensile strength. Hand riveting promotes the formation of cracks in rivets. Time after quenching and the size of the clearance between the shank and the hole act similarly. Standard specifications for duralumin rivets used in Russia are given. (11d)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Refining of Bismuth. (Das Raffinieren von Wismuth.) THEWS. *Die Metallbörse,* Vol. 21, Sept. 12, 1931, pages 1705-1706.

The starting materials for the production of refined Bi are given and the removal of the following impurities are fully described: As, Cu, Pb, Zn, Te, Au, Ag. 10 references. EF (12a)

Melting of Grey and Malleable Iron in the Indirect-Arc Furnace. J. C. BENNETT & J. H. VOGEL. *Iron & Steel Industry,* Vol. 5, Oct. 1931, pages 19-21.

Condensed from a paper before the American Foundrymen's Association. Discusses results obtained, handling methods and costs. Higher costs are balanced by great flexibility of the furnace. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 312. CHL (12a)

The Scientific Principles of Open Hearth Steel Production. (Die wissenschaftlichen Grundlagen des Herdofenschmelzens der Stahlerzeugung.) E. LUBOJATZKY. *Montanistische Rundschau,* Vol. 24, Jan. 1, 1932, page 1-8; Jan. 16, 1932, pages 1-5; Feb. 1, 1932, pages 5-8.

The paper endeavors to systematically discuss the metallurgy of the open hearth process on the basis of our present knowledge. After establishing the saturation limit of FeO in Fe in dependence on the temperature, the law governing the distribution of FeO between slag and metal bath is investigated and the process of diffusion of FeO from the slag into the metal is explained by means of the osmotic pressure, the capillary attraction, Euler's continuity equation and considerations on the separation of admixtures which have been given by the author in previous publications in "Montanistische Rundschau." The relations of equilibrium for the oxidation of C, Mn, Si and P are reviewed. The theory of desulphurization which is based on Nernst's rule on the vapor pressure of oxides and sulphides is corroborated by practical experiments. The qualitative effect of Mn and Si on the deoxidation and the separation of the silicates formed is discussed. As to the quantitative possibilities of the deoxidation effects of these elements former investigations of the author are referred to. The physical laws favoring the formation of slag components which favorably affect the refining in the open hearth are summarized. Finally, it is pointed out that all occurrences in the open hearth must be correlated in order to successfully study the process. 45 references. GN(12a)

Casting & Solidification (12b)

Permanent Mould Foundry Practice for Bronze Castings. H. MARIUS. *Metal Industry,* London, Vol. 39, July 24, 1931, pages 75-76; July 31, 1931, pages 103-104.

See *Metals & Alloys,* Vol. 2, July 1931, page 135. (12b)

Rolling (12c)

Aluminium Sheet Production. Part XI. Planning Methods. Part XII. Rolling Operations. ROBERT J. ANDERSON. *Metallurgia,* Vol. 5, Jan. 1932, pages 87-90; Feb. 1932, pages 127-129; Mar. 1932, pages 161-163; Apr. 1932, pages 201-202, 208.

Gives methods for keeping records, scheduling and calculating amounts and sizes of slabs required for various sheet orders. Discusses rolling of slabs prior to finishing to gage. JLG (12c)

Slab Mill Driven by Three Reversing Motors. A. F. KENYON (Westinghouse Elec. & Mfg. Co.). *Blast Furnace & Steel Plant,* Vol. 19, Dec. 1931, pages 1560-1561, 1571.

Describes electric drive for a 44-in. reversing universal slabbing mill in the Chicago district. Ingots up to 30"x64" in cross section and weighing as much as 40,000 lbs. can be rolled. Main horizontal rolls are driven directly without pinions by a 10,000 h. p. twin motor drive consisting of 2 double armature, 5,000 h. p., 700 volt, 40-80 r.p.m., d.c. reversing motors. Combined maximum torque is 1970 ton-ft. corresponding to a peak capacity of 28,000 h. p. at 37 r.p.m. Vertical edging rolls are driven, through reduction and miter gearing, by a 2500 h. p., 700 volt, 79-225 r.p.m., single armature, d.c. reversing motor, with maximum emergency torque capacity of 250 ton-ft. at speeds up to about 74 r.p.m. Motors are connected in parallel and supplied with variable voltage d.c. power from a 5-unit, 6 bearing flywheel motor-generator set consisting of three 3500 kw., 700 volt, compound generators, connected in parallel, a 6500 h. p., 3-phase, 25 cycle, 6600 volt, 370 r.p.m. wound rotor induction motor, and a 90-ton, 15 ft. diameter steel plate flywheel, when running at synchronous speed of 375 r.p.m., rotating parts have a total stored energy of 270,000 h.p.-sec. Installation represents greatest power and torque applied to a reversing mill. MS (12c)

Forging (12d)

Production Control in Drop Forge Plants. L. E. RUBY (Pittsburgh Forgings Co.). *Heat Treating & Forging,* Vol. 17, Nov. 1931, pages 1029-1033.

Discusses organization, operation and functions of a production control department. A unified production department and careful planning of every job greatly simplify operations and reduce costs. Forms used are illustrated. MS (12d)

Modern Drop and Die Hammers in Forging Practice. (Neuzeitliche Fall- und Gesenkhämmer in Gesenkschmieden.) S. WEIL. *Stahl und Eisen,* Vol. 52, Feb. 11, 1932, pages 144-148.

Improvements that have been carried out with drop hammers and swaging hammers in recent times are brought out in discussion and illustrations. Examples of the latest improvements are shown for lifting device, regulating device for a punch, stamp and die, rebound, drive for lift, plunger, flexible connection between the piston rod and the hammer plunger, etc. DTR (12d)

Behavior of Metals During Hot Pressing. (Verhalten der Metalle beim Warmpressverfahren.) *Die Metallbörse,* Vol. 21, Apr. 18, 1931, pages 724-725; May 16, 1931, pages 916-917; May 23, 1931, pages 964-965.

Summarizes the research work of Tammann, Tucker, Genders, Doernickel & Trockels, Pearson, Met and Smythe, with emphasis on the contributions of the last 3 investigators. EF (12d)

Machining (12g)

Cutting Steel with a New Cemented Carbide. ROGER D. PROSSER (Thomas Prosser & Son). *Machinery,* Vol. 38, Dec. 1931, pages 296-298.

Gives results of tests conducted on Widia-X to determine its capacity for machining steel. Permits increased speed and does not "crater" readily. Gives some suggestions for its use. RHP (12g)

Machinability of Free-cutting Brass Rod. ALAN MORRIS (Bridgeport Brass Co.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 454, 10 pages.

The "machineability" of free-cutting brass and a few other alloys was determined by means of a pendulum-type cutting machine in which the single tool swept out a section of the specimen and the energy used was measured by the swing of the pendulum. In the 60:40 brass a variation in the Cu content of several % had practically no effect on the machineability. As the Pb content of the brass increased the machineability increased rapidly up to 3 or 3.5% Pb. Heat treatment changed the machineability, and the machineability was apparently decreased by the β phase. Machineability was improved by cold work. Machineability could not be predicted from the tensile strength. 2 references. JLG (12g)

Machining Electro-deposited Nickel. C. H. FARIS. *American Machinist,* London, Vol. 74, Jan. 29, 1931, pages 68E-69E.

Tables are given for the grain size and hardness and velocity of grinding wheels and cutting velocities for turning and milling of electrolytically deposited Ni. Ha (12g)

Cutting Threads on a Rolling Gear Cutting Machine. (Gewindebearbeitung auf Räder-Wälzfrasmaschinen.) KURT GLASER. *Maschinenbau,* Vol. 10, Aug. 20, 1931, pages 532-534.

Various methods are discussed and the rules for choosing the correct method as well as the correct load are given. MAB (12g)

Drawing & Stamping (12h)

Reduction of Cost of Production of Steel Tube Connections by Combining Cold Drawing and Hot Pressing (Kostenverringernde Herstellung von stählernen Rohrverbindungen durch Kombination von Kaltziehen und Warmpressen). *Das Werkzeug (supplement to Maschinenkonstrukteur-Betriebstechnik).* Vol. 7, June 10, 1931, pages 127-128.

The crude material is prepared in a skillful way for hot-pressing by cold stamping and drawing. The method permits many variations and appears promising. MAB (12h)

The Production of Motor Laminations. R. L. PAYNE. *Metal Stampings,* Vol. 4, June 1931, pages 481-486.

There are three methods in common use for reducing Si steel sheets to strips for the production of motor laminations. A gang slitter cuts the sheet lengthwise into a number of unscalloped strips; a scroll shear cuts out scalloped strips along the width of the sheet; while a double crank press, equipped with either a 3-stage scalloping die or a 2-station progressive die, cuts the sheet lengthwise into scalloped strips. A fourth method uses a double crank press with a staggered gang die for blanking out plain lamination discs or wafers. JN (12h)

Thin Strip Steel for Deep Drawing. H. T. MORTON & I. A. RUMMLER (Hoover Steel Ball Co.). *American Society for Steel Treating Preprint* No. 21, 1931, 8 pages.

Paper read and discussed before the Boston Convention of the Society in Sept. 1931. The authors discuss tests for control of the quality of hot and cold rolled strip steel for deep drawing work. WLC (12h)

Pickling (12i)

Etching Aluminum Ware. (Das Beizen von Aluminiumstücken.) STEGER. *Zeitschrift für die gesamte Giessereipraxis; Das Metall,* Vol. 52, Jan. 11, 1931, page 12.

The compositions of solutions to give bright and matte finishes to Al articles and their methods of use are given. WHB (12i)

Influence of Pickling Operations on the Properties of Steel. H. SUTTON. *Rolling Mill Journal,* Vol. 5, Apr. 1931, pages 275-280, 290.

11 references. The pickling of iron and steel usually produces an effect of brittleness. The resultant changes in physical properties are attributed to the presence of absorbed hydrogen. The acid cleaning of low and medium-carbon steels is not detrimental and the brittleness produced is but temporary. In 10% H_2SO_4 solution, or in an equivalent solution of acid sodium sulphate, HCl, or HF, the degree of brittleness increases also with the temperature of pickling up to 122° F. This embrittling effect disappears gradually at room temperatures and more rapidly at higher temperatures. Bend tests and tensile tests made on laboratory test strips before and after pickling agree with these statements. A heat-treated Ni-Cr steel strip, however, displays very little brittleness after pickling. Electrolytic pickling in H_2SO_4 solution results in severe embrittlement, which disappears on heating to 212° F. Electrolytic pickling in caustic soda solution, sodium cyanide or a mixture of sodium carbonate and sodium bicarbonate produces but a slight embrittling effect. Cracks may develop during pickling in the case of steels that have been subjected to strain and insufficiently annealed. The addition of 2% pyridine or quinoline to an acid pickling bath may reduce the embrittling effect considerably. Hydrogen brittleness may be imparted to steel by the operations of electro-plating. This is a more permanent form of brittleness and requires more vigorous attention than does the brittleness resulting from acid pickling. JN (12i)

Cold Working (12j)

Mechanics of Chipless Forming; Rolling, Pressing, Drawing, etc. (Mechanik der spanlosen Formung; Walzen, Pressen, Ziehen, usw.). G. Sachs. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Jan. 16, 1932, pages 49-54.

The author points out that at the present time the flow phenomena of solid bodies, plasticity phenomena, still lack a mathematical treatment which would permit a practical prediction of behavior. The simplest question is that of the amount of energy required for a certain deformation; from this, the actual distribution of stresses should then be derived. The calculation and methods of taking of flow curves is discussed and diagrams are developed to show the behavior of and the distribution of stresses in a piece of metal after different kinds of mechanical treatment. The process of deep-drawing is also investigated, and calculated and tested curves for the press force against the path of the press plunger are given. 18 references. Ha (12j)

Methods used in Fabricating Allegheny Metal. *Machinery,* Vol. 38, Dec. 1931, pages 244-246.

Allegheny metal is an 18-8, Cr-Ni alloy having an ultimate tensile strength of 90,000 to 100,000 lbs./in.^{2} Elongation 60 to 70%. Little cold working will increase the tensile strength to 120,000 to 125,000 lbs./in.^{2} Discusses correct procedure in turning, cutting, drilling, punching, drawing, and pickling. RHP (12j)

Coldwork Method of Gun Construction. T. C. Dickson. *Army Ordnance,* Vol. 12, Nov.-Dec. 1931, pages 188-195.

The designer, maker and user of guns are not interested in "slip," "yield," "creep," "step," "slippage" and similar phenomena exhibited by the metal when in the form of solid cylindrical specimens, but they are interested in the maximum pressure to which a given gun can be subjected repeatedly with safety. Whatever may be the various phenomena produced in steel during coldworking, the practical fact remains, that single piece guns have been made by the coldworking process (enlargement of the diameter of the bore by coldworking from 1-12%) which, for the same dimensions and weight, are stronger than built-up guns. Experimental results show the maximum beneficial results are obtained by soaking hollow cylinders after enlargement of the diameter by coldworking at about 325° C. Centrifugally cast guns are normally coldworked to about 12% enlargement of the bore diameter, and soaked at 300° C. after coldworking. The advantageous results obtained on soaking hollow cylinders at low temperatures after coldworking are strongly emphasized. The soaking temperature should not exceed 325° C. This phenomenon does not apply to solid cylinders after coldwork as much as it does to hollow cylinders. This process of overstraining metals was developed primarily for making guns. It should, however, have useful applications industrially. The process should be carried out so the removal by machining of as little metal as possible from the bore is necessary. The Charpy impact value of the finished material after soaking is not less than 24 ft. lbs. if the safest results are desired. WAT (12j)

Improvements in the Cold Working of Metals. J. R. Miller. *Heat Treating & Forging,* Vol. 17, June 1931, pages 559-561.

Diffraction patterns show the different orientation of crystals for sheet rolled by driven rolls or drawn through rolls, both for annealed and for unannealed sheets. A diagram of a 4-roll mill for rolling strip metals under improved conditions of driven rolls is given. Ha (12j)

Preferred Orientation in Silver Foil Produced by Cold Rolling. Cleveland B. Hollabaugh & Wheeler P. Davy. *Journal of Rheology,* Vol. 2, July 1931, pages 284-291.

The mechanical working of silver foil by rolling produces 2 preferred orientations of crystals. Published work, heretofore, has given but a single position. The preferred orientation and the degree of preferment of each have both been found. See also *Metals & Alloys,* Vol. 2, Jan. 1931, page 12. WHB (12j)

Influence of Cold Working and Annealing on Brittleness of Copper. Clement Blazey. *Metal Stampings,* Vol. 4, Dec. 1931, pages 975-976, 986.

The factors causing brittleness in Cu cold worked and annealed are: annealing below a critical temperature, about 650° C., quenching from above the critical temperature; presence of As, P or Bi. The conditions are discussed in detail; it can be stated that Cu free from brittleness can be obtained when it is annealed above the critical temperature and quenched. Ha (12j)

Changes of Physical Properties by Cold Working and Formation of Solid Solutions and their Interpretation with Particular Reference to Tungsten. (Ueber die Zusammenhänge zwischen Kaltbearbeitung und Mischkristallbildung und ihre Deutung. Unter besonderer Berücksichtigung des Wolframs.) C. Agte & K. Becker. *Physikalische Zeitschrift,* Vol. 32, Jan. 15, 1931, pages 65-80.

The influence exerted by the solid solution on one hand and by cold working on the other hand on the physical properties is exhaustively treated with particular reference to W. The writers consider the effect of cold working on the tensile strength values, reduction of area, and the torsion modulus. Then the effect of heat treatment on the cold worked metal and the occurrence of elastic internal stresses due to deformations is dealt with. Furthermore the influence of additions resulting in the formation of solid solutions are considered with reference to the following systems: W-Ta, W-Mo and Zn-Cd single crystals. The effect of deformations by hammering and drawing on density and hardness are reviewed and the changes of electric properties due to (a) cold working and (b) formation of solid solutions is summed up. The statements selected from an extensive literature search are summarized with the object of disclosing analogies between the influence of cold working and the solid solution on both mechanical and electrical properties and the Mathiessen law is discussed. Furthermore the changes in (a) thermal, (b) optical and magnetic and (c) chemical properties by cold working and mixed crystal formation are covered in separate chapters. EF (12j)

DEFECTS (13)

Note on a Failure of a High Strength Brass. NEWSON & WRAGG. *Engineer,* Vol. 152, Sept. 1931, page 331.

Abstract of paper read before the Institute of Metals, Zurich, Switzerland, Sept. 1931. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 45. LFM (13)

Rail Failures in India. E. A. WRAIGHT & P. HINDE. *Iron & Coal Trades Review,* Vol. 122, June 19, 1931, page 982.

The majority of failures in the Indian rail service are due to defects in manufacture; they are described and special cases discussed. Heat-treated rails are not used. See *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 75. Ha (13)

Influence of Metallic and Non-Metallic Inclusions Upon the Properties of Bronzes. (Einfluss der metallischen und nichtmetallischen Verunreinigungen auf die Bronzen.) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Feb. 7, 1932, page 67.

The effect of Sb, Pb, As, Fe, S, O and gases on the mechanical properties of bronzes is discussed. As is not so dangerous as generally assumed. GN (13)

Boiler Failures and Their Causes. *Engineering,* Vol. 132, Aug. 21, 1931, pages 241-243.

Summary of reports presented at the annual meeting of the German Association of Boiler Owners held recently at Dresden. LFM (13)

CHEMICAL ANALYSIS (14)

The Determination of Sulphur in Alloy Steels (Die Bestimmung des Schwefels in legierten Stählen). C. HOLTHAUS. *Archiv für Eisenhüttenwesen,* Vol. 5, Aug. 1931, pages 95-100.

Report 83 of the Chemist' Committee of the Verein deutscher Eisenhüttenleute. Report of the Sub-committee on the analysis of special steels. Includes discussion. The investigation critically examined the various methods of determining S in alloy steels. The methods tested were the following: the ether method: the combustion in O and the iodometric method according to Reinhardt. These methods were used to determine the S content of the following steels: a 2% and an 18% W steel, a 2% and a 9% Cr steel, a 0.3% and a 3% Mo steel, a 0.5% and a 2.2% V steel, a 5% and a 25% Ni steel, a 3% and a 10% Co steel, a 0.3% Cu steel, a 1% Al steel, a 12% Mn steel, and a 1% Ti steel. Some of these steels are taken from the normal production some of them were especially made in a coreless induction furnace by adding FeS. The results are as follows: (1) The ether method gives results of great accuracy with all the above steels. (2) Practically the same reliable results are obtained with the combustion method.

In comparison with the ether method, the combustion method offers the advantage of an essentially quicker performance. (3) The method (still in use in many laboratories) of determining the S content in alloy steels by dissolving the steel in hydrochloric acid gives reliable results only with low Ni steels, Co steels, Cu steels, Al steels and Mn steels. This method is no more reliable for V steels and entirely unfit for steels containing W, Cr, Mo, Ti and a higher percentage of Ni. In steels of such a composition it is necessary to determine the S content of the residue remaining after the solution in HCl. Due to this procedure, the iodometric method becomes most complicated and easily leads to incorrect values because of the many sources of error involved. The investigation arrives at the conclusion that S in alloy steel is most suitably determined by either the ether method or the combustion method. GN (14)

The Use of Zinc Oxide in Determinations of Cobalt and Manganese. JAMES I. HOFFMAN. *Bureau of Standards Journal of Research,* Vol. 7, Nov. 1931, pages 883-892.

If a precipitation by zinc oxide is made in a solution of a steel obtained by dissolving the steel in HCl or H_2SO_4 and oxidizing with HNO_3, the precipitate will contain all of the Fe, W, Va, Cr, U, Zr, Ti, Al, P, As, Sn, and nearly all of the Cu, Mo and Si. Ferrous Fe, W, if not previously oxidized, and small quantities of Si, Cu, Mo, Sb, Pb may be expected in the filtrate if these were present in appreciable amounts. Small amounts of sodium carbonate in the zinc oxide used in separating Co and Mn from Fe, Cr, etc., are not objectionable if only a slight excess of reagent is added. Separations of Fe and certain other constituents of steel from Co and Mn by precipitating with zinc oxide are satisfactory if double precipitations are made. Results for Co tend to be low if only a single precipitation is made. Neither single nor double precipitations are entirely satisfactory for the separation of large amounts of Ni. The temperature at which precipitations by zinc oxide are made has very little influence on the results. WAT (14)

Iodometric Determination of Small Quantities of Tin. (Ueber die jodometrische Bestimmung kleiner Menger Zinn.) ROB. HOELTJE. *Zeitschrift anorganische und allgemeine Chemie,* Vol. 198, June 10, 1931, pages 287-296.

The purpose of this investigation was to find how exactly Sn in amounts of one mg. and less can still be determined by the usual analytical methods; a modification of such method is described. Bi-valent Sn can be determined by titration with iodine solution and re-titration with thiosulphate. Quarta-valent Sn must first be reduced, most suitably by powdered Fe. In both cases the Sn, in amounts of 1 mg. and less, can be determined with an accuracy of about 5 g. Ha (14)

Rapid Determination of Chromium in Chrome and Chrome Nickel Steel. (Chromschnellbestimmung in Chrom-Chromnickelstahl.) W. HILD. *Chemiker Zeitung,* Vol. 55, Nov. 21, 1931, page 895.

A 2 g. sample is dissolved in 10 cc. HNO_3 sp. gr. 1.20, 20 cc. 1:1 H_2SO_4 and 150 cc. hot H_2O. 20 cc. $KMnO_4$ solution (8 g./liter) is added and the solution boiled for 4 min. The excess MnO_2 is reduced with 8 to 10 cc. $MnSO_4$ solution (100 g./liter). The solution is boiled, filtered through double paper, refiltering the first portion, and washed with hot water. After cooling, the solution is titrated in the usual manner. Accurate results can be obtained in 13 to 15 min. CEM (14)

Critical Investigation of the Reliability of the Vacuum Fusion Method for Determination of Oxygen in Steel (Kritisk undersökning över vakuumextraktionsmetodens användbarhet för bestämning av syre i järn och stal). G. ERICSON & C. BENEDICKS. *Jernkontorets Annaler,* Vol. 114, Nov. 1931, pages 549-589.

The vacuum fusion method was subjected to a detailed investigation and found to give a 100% yield of oxygen provided a uniform temperature is maintained on the graphite crucible, and loss of sample by spattering or volatilization is guarded against by a filter of glowing graphite particles. Cr, Mo, Ti, V and W do not affect the determination, but low results are obtained with an Al content of more than 2%. Mn introduces an error by volatilizing and depositing on the sides of the quartz furnace where it reabsorbs some O_2. HCD (14)

Determination of Oxygen in Steel by Hot Extraction. (Beitrag zur Sauerstoffbestimmung im stahl durch Heissextraktion.) P. BARDENHEUER & J. SCHNEIDER. *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 13, report 189, 1931, pages 215-221; *Stahl und Eisen,* Vol. 51, Dec. 17, 1931, page 1575.

The experiments were carried out in the apparatus as described by G. Thanheiser & C. A. Müller, *Mitteilungen Kaiser Wilhelm Institut für Eisenforschung,* Vol. 11, 1929, pages 87-94, which was improved in some details in order to obtain reliable results at temperatures up to 1600° C. The method was then tested on a large group of melts. The results show that Mn contents up to 1% do not disadvantageously affect the result of the oxygen determination. In Si bearing steels the reduction of the silica present offers no difficulties at sufficient high temperatures. Also alumina is completely reduced. The results were checked by the residue-chlorination method and found to be in accordance with this method. However, reliable results are obtained only when the evaporization of larger amounts of Al is avoided. Summarizing it can be stated that the hot extraction method for the determination of oxygen gives reliable results in investigating the total oxygen content of the largest number of the technical steels. 7 references. GN(14)

Technical Methods of Chemical Analysis. (Chemische-technische Untersuchungsmethoden.) BERL-LUNGE. Vol. II, Parts 1 and 2, 8th edition. Julius Springer, Berlin, 1932. Part 1, Cloth, 6½ x 9½ inches, 878 pages; Part 2, Cloth, same size, 917 pages. Price, Part 1, 69RM; Part 2, 69 RM.

Lunge's "Technical Methods of Chemical Analysis" needs no introduction to American chemists. The eighth edition issued under the name of Berl-Lunge will include 5 volumes, the first of which appeared in 1931. The second volume is issued in 2 parts. Part I includes the table of contents, and part II the author and subject index.

The arrangement of material is much the same as in earlier editions. The various sections have been written by experts in their respective lines. The first 454 pages of part I are devoted to the analysis of solid, liquid, and gaseous fuels; boiler, drinking, and waste water; and air. The remainder is devoted to the manufacture of the following products and the analyses involved therein: Sulphur dioxide; nitric, sulphuric, hydrochloric, and hydrofluoric acids; soda; chlorine; compressed and liquid gases; potash salts, and bromine. When the subject matter concerns a given industry the usual procedure is to discuss first the raw materials, then the intermediate products and plant-control methods of analysis, and finally the methods of analysis of the finished products.

Part II contains a short chapter on sampling of ores, metals, etc., and also a short section on the balance. Eighty-four pages are devoted to electro-analytical methods. This section consists of a short introduction followed by electro-analytical methods for silver, gold, bismuth, cadmium, cobalt, copper, mercury, nickel, lead, palladium, platinum, rhodium, antimony, tin, and zinc. Methods of separation from other elements are given.

The remaining 746 pages of part II are devoted to methods of analysis for the following elements: Silver, aluminum, arsenic, gold, beryllium, bismuth, calcium, cadmium, cobalt, chromium, copper, iron, hafnium, mercury, iridium, magnesium, manganese, molybdenum, niobium, nickel, osmium, lead, palladium, platinum, rhodium, ruthenium, antimony, silicon, tin, tantalum, thorium, and the rare earths, titanium, uranium, vanadium, tungsten, zinc, and zirconium. One hundred and forty-four pages are devoted to iron. Each element is treated in much the same manner. In a short introduction, the occurrence, minerals, manufacture, use, and importance are briefly described. General methods of determination are then described, and these are followed by methods of separation from other elements. Detailed methods of analysis of ores, various metallurgical products, metals, alloys, salts, etc., are then given. Analytical methods for various impurities present in the products are included. Usually several methods of analysis are described, and gravimetric, volumetric, and colorimetric methods are included when available. In many instances short methods are also described. At the end of many chapters typical analyses of ores, metals, alloys, etc., are given. It is regrettable that the chapter on iron does not include methods for determining non-metallic inclusions.

References are profuse in both parts. The eighth is a fitting successor to earlier editions. Both parts are excellent additions to the library of a research laboratory. Since part II covers in an excellent manner the analysis of a large number of metals and their products, it is especially recommended for chemical and metallurgical laboratories that might be prevented, owing to the high cost, from buying the entire volume. John D. Sullivan (14)-B-

Steel Plant Chemistry (Beiträge zur Eisenhüttenchemie. April-June 1931). A. STADELER. *Stahl und Eisen,* Vol. 51, Nov. 19, 1931, pages 1439-1441.

Eight publications are reviewed on (1) equipment, (2) analysis of pig iron, steel, ores, slags, additions, refractories, etc., and (3) fuels, gases, oils, etc. GN (14)

ECONOMIC (16)

South Africa in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 20.
Au output in South Africa increased by 154,386 ozs. to 10,874,146 ozs. AHE (16)

Manganese. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 12.
General economic conditions in 1931 are discussed. AHE (16)

Nigeria in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 21.
Nigeria produced 15,335 tons of 70% Sn ore in 1929, 11,902 tons in 1930 and about 10,500 tons in 1931. AHE (16)

Spain in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 48.
Apart from Fe and Cu, Spanish mine production was fairly normal in 1931. Figures are given. AHE (16)

Chromium. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 12.
The British Empire yields 2/3 of the world production of Cr from southern Rhodesia, the Transvaal, and British India. Output for 1931 is greatly below the 1930 figures (600,000 tons). AHE (16)

Cornwall and Devon in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 24.
The mining industry in Cornwall and Devon was at a standstill in 1931. AHE (16)

Norway in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 23.
Exports for 1931 were about ½ those of 1930. Pyrite production was about 365,000 tons, Fe about 570,000 tons, Ag 9½ tons, Ni 75,000 tons, and Mo concentrates 182,000 kg. AHE (16)

New Zealand in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 22.
Au production in 1931 increased over 1930. AHE (16)

Australia in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 22.
Au production for the 1st 6 months of 1931 was 258,359 ozs. (218,009 ozs. for 6 months of 1930). AHE (16)

Portugal in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 21.
As, Sn, Cu, W and Pb are mined in Portugal. Sn was the only one produced in quantity in 1931. AHE (16)

Eastern Canada in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, pages 17-18.
In 1931, Ontario produced Au $42,000,000, Ni $16,000,000, Cu $10,000,000, Pb $2,500,000, Ag $2,000,000 and Co $650,000. Total output was similar to 1928. Details are discussed. Quebec produced some $6,000,000 worth of metals. AHE (16)

Statistics on Swedish Production, Import and Export of Iron Ore, Iron and Steel. (Uppgifter över Sveriges tillverkning, in- och utförsel av Järnmalm, Järn och Stal.) *Jernkontorets Annaler,* Vol. 114, Sept. 1931, pages 487-492.
Export ore dropped to 2,173,000 T. for the first 6 months of 1931 from 5,026,000 T. for the corresponding period of 1930. Iron and steel exports are down to the lowest level reached in the last decade 80,900 T., the greatest being 131,700 T. in 1927. Imports are down to 180,000 T. as against 225,800 T. for 1930 and 170,300 for 1929. No tendency towards improvement is visible. HCD (16)

Iron and Steel in Manchuria. *Foundry Trade Journal,* Vol. 46, Feb. 11, 1932, page 104.
A brief statement of the iron and steel situation in Manchuria and the manner in which it affects the pig-iron situation in Japan. OWE (16)

The Gold Supply Increases. S. D. Strauss. *Engineering & Mining Journal,* Vol. 132, Apr. 1932, pages 210-214.
Gold production continues to increase. In a world of stagnant trade it is probably the most important factor now making for economic recovery. WHB (16)

Chromite in 1930. Lewis A. Smith. *Mineral Resources of the United States,* 1930, United States Bureau of Mines, part 1, Dec. 21, 1931, pages 243-266.
World production of chromite in 1930 decreased about 18% to 492,000 long tons. The U. S. imported 327,000 long tons, an increase of nearly 3%. In the U. S. 310 long tons were mined, all in Calif. (543 tons in 1929). Increased use of high-Cr alloys held up the consumption somewhat. Production of chromic acid for Cr plating increased. (Includes 100 references). AHE (16)

Nickel in 1931. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 11.
Ontario production of Ni in 1931 declined 36% to 66,103,521 lbs. The main development of the year was the use of Ni-clad steel for tanks and for tank cars for caustic. Ferro-Ni alloys containing 20-30% Ni and 2% Cr is being adopted for fittings in caustic plants and paper mills. Melting and cyanide pots of Ni 14, Cu 6 and Cr 2% are finding use. Other new uses are described. AHE (16)

A Review of Recent Discussion Regarding Gold Money. Scott Turner (U. S. Bureau of Mines). *Mining Congress Journal,* Vol. 17, Dec. 1931, pages 662-664, 670.
Includes world's production of gold and silver, 1876-1930 inclusive, in millions of ounces. DTR (16)

The Rehabilitation of Silver. Marshall W. Tuthill. *Mining & Metallurgical Society of America, Bulletin* No. 223, Vol. 25, Jan. 1932, pages 13-19.
A plan submitted by the Sub-Committee of the International Chamber of Commerce in Washington to seek a solution of the consequences of the present Ag situation with reference to the economic condition of the world is discussed. Bimetallism would very likely become universal but whatever plan is adopted it must be based on a concerted action of all nations concerned. Ha (16)

Magnesium and Its Compounds in 1930. Paul M. Tyler. *Mineral Resources of the United States,* 1930, *United States Bureau of Mines,* Part 1, Dec. 1931, pages 181-203.
The output of new ingot Mg in 1930, 1,173,557 lbs., was more than double the output in 1928 and only 12% less than in 1929. Prices fell from $1.00 to $0.48 per lb. in 100 lb. lots. Improvements in technology are reviewed. AHE (16)

The Coming Rise in the Value of Silver. A. J. Wright (A. J. Wright & Co.). *American Metal Market,* Vol. 39, Jan. 8, 1932, pages 3-4.
Prediction that the value of silver will rise from now on. DTR (16)

Iron and Steel in 1931. J. H. Thompson. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 10.
Pig Fe production in 1931 was about 56 million tons, crude steel, 70 million, a decline of about 40% from 1929. AHE (16)

Consumption of Primary Tin in the United States During 1930. John B. Umhau. *Information Circular* 6564, *United States Bureau of Mines,* Jan. 1932, 7 pages.
In 1930, 65,448 long tons of primary Sn were consumed, a 12% decrease from 1928. This is 38% of the world's Sn production. All uses showed substantial decreases except Sn plate, terneplate, white metal and tinning which showed small increases (1,200 tons). The largest tonnage decrease was in babbitt (33%). Consumption by uses is discussed. AHE (16)

Gold in 1931. E. Baliol Scott. *Mining Journal,* Annual Review No., Feb. 13, 1932, pages 1-2.
With the exception of Southern Rhodesia every country increased Au production in 1931. Total increase was over 936,000 ozs. AHE (16)

Tin in 1931. E. Baliol Scott. *Mining Journal,* Annual Review No., Feb. 13, 1932, pages 5, 7-8.
Production, consumption and price of Sn declined in 1931. Estimated production was 144,343 tons, a decrease of 27,858 tons. Cartels and trade agreements are discussed. AHE (16)

Lead and Zinc in 1931. O. W. Roskill. *Mining Journal,* Annual Review No., Feb. 13, 1932, page 9.
Pb and Zn suffered in the general decline of 1931. Cartels are discussed. AHE (16)

The Mineral Industry during 1930. Vol. 39. Edited by G. A. Roush. McGraw-Hill Book Company, New York, 1931. Cloth, 6½x9½ inches, 815 pages. Price $12.00.
So far as is possible, this volume covers the developments of the year in each individual field, including production and trade statistics, technical progress, extensions of plants, new sources and uses, market conditions and prices and other items of interest, both domestic and foreign, each subject being placed in the hands of a specialist. In the list of contributors one new name is included, that of George S. Herrick, who has taken over the iron and steel section. Frank L. Hess, after one year's absence, again has taken up the section on radium, uranium, and vanadium.
As one further step in the consolidation of related subjects, the former separate section on borax has been incorporated in the chapter on sodium salts. In addition to the regular sections found in past volumes, an interesting and valuable graphical record of metal prices over a long period of years has been included. (16)-B-

The Possibilities and Prospects for the Utilization of Canadian-Produced Copper in Home Manufacturing Industries. A. H. A. Robinson & W. H. Losee. *Canada Department of Mines, Mines Branch, Report No. 723,* 1931, pages 52-77.
See *Metals & Alloys,* Vol. 2, Mar. 1931, page 74. AHE (16)

Gold and Silver as Money Metal. T. A. Rickard. *Metal Industry,* London, Vol. 40, Jan. 1, 1932, pages 11-13.
Paper read before Institution of Mining & Metallurgy, Dec. 17, 1931. An economic study of the production of gold and silver with regard to bimetallism. PRK (16)

Manganese and Manganiferous Ores in 1930. Robert H. Ridgway. *Mineral Resources of the United States,* 1930, Part 1, Jan. 25, 1932, pages 297-332.
Falling prices, decreased imports and increased domestic production characterized the 1930 Mn industry in the U. S. Domestic production of Mn ore 35% or more of Mn increased 11% to 67,035 long tons but was still insufficient for requirements. Shipments of ferruginous Mn ore were 77,417 tons (78,191 in 1929), and of manganiferous Fe ore were 707,973 tons (1,110,067 in 1929). Production of ferro Mn was 274,830 tons (339,205 in 1929) and of spiegeleisen was 87,059 tons (137,143 in 1929). (15 references). AHE (16)

The Magnesium Industry in France. (L'Industrie du Magnesium en France.) F. Ravier. *Chimie et Industrie,* Vol. 26, Dec. 1931, pages 1263-1270; Vol. 27, Jan. 1932, pages 32-40.
The author discusses the general situation of the Mg industry in France, giving his examination of the various industrial processes with practical details on the construction and operation of electrolyzers. He emphasizes particularly the importance of the principles which guide the industry, as well as some points which seem to him to be important but which are not usually found in the literature. A historical summary is given, followed by the statistics of the industry in the United States as compared with those of it in France. He includes the patents on the various processes. MAB (16)

Gold Deposits of Jakutien. (Die Goldlagerstätten von Jakutien.) N. Palutoff. *Zeitschrift für praktische Geologie,* Vol. 39, Oct. 1931, pages 121-125.
Jakutien is the north-eastern part of Siberia with an area of 4,000,000 sq. km. In the Upper Olekma district of this territory the Au production rose from 132 kg. 381 g. in 1844-48 to 400 kg. in 1915-16. In upper Timpton district from 7 tons 700 kg. for the period 1903-11 to 141 kg. 700 g. in 1922. In Ssutam district in 1899-1911 7 tons 378 kg., in 1918, 188 kg. 180 g. Upper Aldan district: no actual Au production as yet. Investigations since 1926. Aldan-Tommot district: from 1923 to 1927 a total of 1716 pud (28 tons 109 kg.) Lower Timpton district is not yet fully investigated, but Au deposits are supposed to be present. Wilui district: the Au deposits contain also Pt, and to a smaller extent Ir, Rh, Pd, Os, Rb, only about 800 kg. Au were produced since 1908. Indigirka district has definite Au deposits. Kolyma district has deposits included in granit-intrusions ab. 700x200 km. According to the origin the deposits could be divided into the following classes: 1) hypothermal deposits of quartz and pegmatit; 2) mesothermal deposits in sedimentary quartz. 3)Epithermal deposits in eruptive quartz with strong admixture of pyrites. 4) Contact deposits; 5) magmatic deposits and impregnations in eruptive rocks; 6) alluvial deposits of secondary origin in Wilui district. JGT (16)

MISCELLANEOUS (20)

The Heat of Formation of the Nitrides, I. Manganese-nitride and Chromium-nitride. (Ueber die Bildungswärme der Nitride, I. Mangannitrid und Chromnitrid.) B. Neumann, C. Kroeger & H. Haebler. *Zeitschrift anorganische und allgemeine Chemie*, Vol. 196, Feb. 14, 1931, pages 65-78.

The experiments for measuring the dissociation pressures of the systems metal-nitrogen are described, but it seems that they can not be determined with sufficient accuracy to serve as basis for numerical calculations; the influence of formation of solid solutions on the calculation of the equilibrium from thermo-chemical formulas remains, therefore, undetermined. Ha (20)

Cold Treating Metallic Alloys. H. S. Rawdon (U. S. Bureau of Standards) *Metal Progress*, Vol. 21, Feb. 1932, pages 29-33.

The author discusses the use of liquid air and solid CO_2 as cooling agents in the production of "shrink" fits in small brass and steel parts, and as refrigerants for retarding the phase changes in duralumin rivets. Results are reported on effects of such temperatures on martensitic and austenitic steels. WLC (20)

The Temperature Variation of Intrinsic Magnetization and Associated Properties of Ferromagnetics. Edmund C. Stoner. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Series 7, Vol. 12, Oct. 1931, pages 737-763.

Ferromagnetic phenomena are divided in 2 groups, those typified by the variation in strength and direction of the magnetization at a single temperature, with strength and direction of an applied field; and those typified by the variation of specific heat with temperature. To explain the general characteristics of both types, the existence of an intrinsic or spontaneous magnetization in the ferromagnetic which varies with temperature is assumed. The relation of this intrinsic magnetization to other properties of ferromagnetics is briefly discussed. Ferromagnetism can be regarded at ordinary temperatures as due to the interchange interaction of electron spins. Values of the magnetization, of the associated specific heat and thermoelectric power of an "idealized ferromagnetic" (one in which the magnetic properties are entirely due to electron spin interaction from absolute zero to the Curie point) are calculated and comparisons with Ni are made. 20 references. Ha (20)

The Buckling Safety of the Continuous Railroad Track. (Ueber die Knicksicherheit des lückenlosen Geleises.) Jos. Nemesek. *Organ Fortschritte des Eisenbahnwesens*, Vol. 86, Aug. 15, 1931, pages 346-350.

The possibilities and difficulties of a continuous track formed by welding are analytically treated taking into account the resistance of the road bed against horizontal and vertical displacement of the rails. Ha (20)

Electron Deflection by Metallic Films. (Ueber Elektronenbeugung an Ionenkristallen). E. Rupp. *Annalen der Physik*, Vol. 3, No. 4, 1929, pages 497-506.

Electrical measuring arrangements have been devised for studying the deflection phenomena which occur when electrons pass through thin sheets of foil, and data have been recorded in the case of a number of metals having cubic lattices, including Ni, Al and Cr. (20)

Shaft Deflection and Its Influence on Bearing Design. H. F. Shepherd. *Machine Design*, Vol. 4, Jan. 1932, pages 42-45.

The practice of mounting machine shafts is discussed and viewed under two principal classes of transversely loaded shafts, depending on whether in the expression $\sqrt{M/F}$ the factor M or F is the more preponderant; M is W/g, and F is the force required to produce unit deflection. The proper alignment or deviation from alignment in bearings is explained. Ha (20)

Experimental Study of Rigid Girders by the Method of Forced Vibrations (L'étude expérimentale des poutres a assemblages rigides par une méthode de vibrations forcées). P. Le Rolland & P. Sorin. *Revue de Métallurgie*, Vol. 28, Nov. 1931, pages 617-629.

The impossibility of calculating the secondary stresses in rigid constructions, by the means of simple loading, lead to the study of the transmission by them of periodical efforts generated from one system to another. A 2 pendulum arrangement of this type is described and the results obtained as well as theoretical considerations involved are given. JDG (20)

On Bearing Metals and Repair Work on Bearings (Ueber Lagermetalle und Lagerreparaturen). W. Schüler. *Deutsche Motorzeitschrift*, Vol. 8, Apr. 1931, pages 146-148.

Critical discussion on bearing metals with particular reference to internal combustion engines. Bearing metals high in Sn are given superiority to alloys on lead basis. Substitution alloys containing Ni, alkaline metals and compounds, graphite, Ba are usually also based on Pb. The second part of the paper treats at length 3 shop methods of casting new bearings. The potentiality of each individual method is critically discussed. EF (20)

Protection against Gases in Metallurgical Plants of the Ruhr-District (Gasschutz in den Hüttenbetrieben des Ruhrgebiets). K. Schwantke (Hütten und Walzwerks Berufsgenossenschaft). *Stahl und Eisen*. Vol. 51, Dec. 10, 1931, pages 1536-1538.

The gases of metallurgical plants are most dangerous, due to the high content of CO. Even such a small percentage as 0.1% in air may have serious effects. Whereas, in former years, the plants of the Ruhr district were only equipped with instruments to revive working men poisoned by gas, protective apparatus are now used and special instruction is given. Thus, the number of fatal accidents could be decreased from 19 in 1919 to 5 in 1930. 1 reference. GN (20)

Alliance Aluminium Compagnie. *Journal du Four Electrique*, Vol. 40, Nov. 1931, pages 429-431.

On the termination of European aluminum cartel agreement, a new society with the above name was organized in Basle in order to develop and promote the uses and manufacturing methods for aluminum. This time the cartel in addition to the old members, was joined by Canada. JDG (20)

Alloy—Mixing Explosion. *Chemical Trade Journal & Chemical Engineer*, Vol. 90, Jan 1, 1932, page 16.

A violent explosion occurred at the works of the British Thermit Co. on Oct. 21, 1931, during the mixing of the ingredients used in the manufacture of an alloy of Al and Cu. The mixing was done on an iron floor and always generated a large amount of heat. It was recommended that workmen be protected in the future with asbestos coats and that the use of iron and steel shovels for mixing be prohibited. JN (20)

Safety Workers Recommend this Self-Inspection Form. *Canadian Foundryman*, Vol. 22, Aug. 1931, pages 11-12.

A group of 12 "things to look for" in a semi-annual inspection of any plant, according to a form issued by the Industrial Accident Prevention Associations of Ontario. OWE (20)

Glass from Slag. *Glass Industry*, Vol. 6, July 1931, page 153.

A news report from Auburn, Ala., states that C. A. Basore, professor of chemistry and research of the laboratories of the Alabama Polytechnic Institute, has developed a method of using Alabama sand and granulated slag from the Birmingham blast furnace districts as ingredients for the manufacture of glass. WAT (20)

Glass from Blast Furnace Slag. *Iron & Coal Trades Review*, Vol. 124, Jan. 8, 1932, page 42.

Successful experiments have been made at the Engineering Experiment Station of the Alabama Polytechnic Institute on the conversion of blast-furnace slag into glass; the slag contains lime and silica and alumina in suitable amounts. The glass obtained is transparent, light-green or colorless, and suitable for bottles, corrosion-resisting linings and X-ray bulbs, goggles, etc. The mix to obtain good results is given, melting requires 100 to 180 minutes at 2500° to 2600° F. with subsequent annealing and slow cooling. Ha (20)

The Effect of Mercury Vapor on Sliding Contacts. R. M. Baker (Westinghouse Electric & Manufacturing Co.). *Electric Journal*, Vol. 29, Feb. 1932, pages 64-65.

The drop across contacts in a non-oxidizing atmosphere is greatly reduced by a small amount of Hg vapor. The contact behaves like a constant-ohmic resistance. It is concluded that: (1) the atmosphere surrounding a contact, whether at atmospheric or pressures as low as 50 microns, has little effect on the electrical characteristics of the contact, (2) a small amount of Hg vapor in a non-oxidizing atmosphere around a sliding contact will result in a very low contact drop, and (3) the change in the contact with the introduction of Hg vapor is such as to make it behave like a constant ohmic resistance. WHB (20)

Steel Sheetpiling Carries Tunnel Through Fault Zone. *Engineering News-Record*, Vol. 108, Mar. 10, 1932, pages 361-364.

A shield of steel sheetpiling driven horizontally, first for a top-center drift and later all around the perimeter proved successful in carrying the New York Water tunnel No. 2 through a short fault zone under the Bronx River. Driving of the 21 foot tunnel was interrupted for 6 months in the effort to progress 50 feet through a heavy water bearing section of disintegrated rock lying between formations of limestone and gneiss. CBJ (20)

Changes in the Mass-Weight Ratio of Alloys Under Compression. Peter I. Wold & Earle M. Bigsbee. *Physical Review*, Vol. 37, 1931, page 460.

Abstract of a paper read before the American Physical Society. C. F. Brush carried out experiments (Pro. Amer. Phil. Soc. Vol. 61, 1922, pages 67-183; Vol. 62, 1923, pages 75-89; Phys. Rev. Vol. 31, 1924, page 364; Vol. 33, 1925, pages 338-339) which led him to conclude that the weight of a metal may change when strained, giving a change in the ratio of mass to weight. His experimental technique seemed to preclude the obvious sources of error which might be urged as explanation of his results. At Brush's request weighings were made by the authors of certain alloys prepared by him. The procedure was practically the same as that described by Brush (Proc. Amer. Phil. Soc. Vol. 63, 1925, pages 36-50). Weighings taken on various specimens showed losses in weight when the specimens were compressed and an almost complete recovery when the stress was removed. The changes were substantially in excess to balance errors. The losses were less than found by Brush, who considered this to be due to annealing during the time between the preparation of the sample and its weighing. The shorter this time the larger were the observed effects. In the last sample studied, where elapsed time was shortest, the losses amounted to 1 part in 130,000. The results may be considered as confirming those of Brush. The suggestion that the effects are due to changes in the amount of adsorbed gases does not appear to be sufficient explanation. WAT (20)

Modern Etching Methods for Lettering of Tools. (Neuzeitliche Aetzverfahren für Werkzeugbeschriftung.) Franz Wende. *Werkstattstechnik*, Vol. 25, Mar. 1, 1931, pages 125-128.

Two methods are described by which tools can be lettered by etching and printing; this method is particularly suitable for gages which must be absolutely protected against any stress occurring in lettering by mechanical means. Ha (20)

Slag Disposal and Utilization. Fredk. Woodifield. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, pages 125-127.

A discussion of the development of the use of slag for the manufacture of slag bricks, cement, and road material, together with a consideration of the effect of the slag composition on its physical properties. CHL (20)

Mathematical Investigation on the Distribution of Currents and Losses due to the Sheet Insulation of Transformers. (Mathematische Untersuchung über die Verteilung der Ströme und Verluste in der gegenseitigen Blechisolation von Transformatoren.) G. Stein. *Zeitschrift für Mathematik und angewandte Mechanik*, Vol. XI, Dec. 1931, pages 433-436.

Iron losses due to hysteresis and eddy currents are influential on the economy of transformers. The transformer core consists of thin sheets insulated against each other to cut down the losses due to eddy currents. The dependence of these losses on the insulation is mathematically treated. The calculation yields 20-40% of the total iron losses depending on the kind of sheet material and its thickness. EF (20)

FOUNDRY PRACTICE & APPLIANCES (22)

Die Casting or Mold Casting? (Spritzguss oder Kokillenguss?) A. Kaufmann. *Aluminium,* Vol. 13, Mar. 1931, pages 1-3.

The basic differences in the 2 methods are explained and the influence of the great difference in cooling of the 2 methods on the properties of metals with particular reference to Al is described. See *Metals & Alloys,* Vol. 2, Sept. 1931, page 187. Ha (22)

Making Castings in Permanent Molds. J. L. Dostal (Holley Permanent Mold Machine, Inc.) *Machinery,* Vol. 38, Dec. 1931, pages 263-264.

Abstract of a paper read at the Production Meeting of the Society of Automotive Engineers, Detroit, Mich., Oct. 8, 1931. Best molds are made from the same iron that is used in the castings. Describes method of making the casting mold, which is faced with a refractory. Lists advantages which include, accuracy, uniformity, less drilling, speed. RHP (22)

Constructive Testing is an Aid to Designers of Castings. F. C. Edwards. *Foundry,* Vol. 59, Dec. 1, 1931, pages 52-55.

Abstract of paper presented at a meeting of the Institution of British Foundrymen at Derby, England. Gives results obtained from tests which show that addition of weight to casting does not always increase the strength but often reduces that property. Constructive testing is helpful since through that method it is possible to determine strength that may be expected from certain design and if necessary redesign casting to give required strength. VSP (22)

The Suitability of Different Oils as Core-Binding Materials. (Ueber die Eignung verschiedener Oele als Kernbindemittel.) H. Nipper & K. Krekler. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 5 pages.

See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 23. (22)

The Conditions of Absorption and Oxidation in Small Cupola Furnaces during the Melting of Steel Scrap. (Zu- und Abbrandverhältnisse beim Einschmelzen von Stahlschrott im kleinen Kupolofen.) E. Piwowarsky, H. Langebeck & H. Nipper. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Oct. 1931, 19 pages.

See *Metals & Alloys,* Vol. 2, Nov. 1931, page 279. (22)

A Simple Method of Molding Hearth Rings. (Ueber ein einfaches Verfahren zum Formen von Herdringen.) E. Schütz. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, April 17, 1932, pages 156-157.

A new molding method for hearth rings is outlined which guarantees a higher production. GN (22)

Moulding A High-Duty Hydraulic Cylinder in Loam. J. J. McClelland. *Foundry Trade Journal,* Vol. 46, Apr. 14, 1932, pages 231-232.

A description of methods adopted in the molding of a heavy-duty hydraulic cylinder. OWE (22)

Cupola Melting for Non-Ferrous Alloys. T. Mauland. *Foundry Trade Journal,* Vol. 45, Aug. 6, 1931, page 90; *Fuels & Furnaces,* Vol. 9, June 1931, pages 683-684; *Foundry,* Vol. 59, July 1, 1931, pages 64-65.

Abstract of a paper presented before the Chicago Convention of the American Foundrymen's Association. See "Cupola Melting of Brass," *Metals & Alloys,* Vol. 2, Oct. 1931, page 229. OWE + Ha + VSP (22)

The Character of Sand Grains. H. Ries & G. D. Conant. *Transactions & Bulletin American Foundrymen's Association,* Vol. 2, Oct. 1931, pages 353-392.

A microscopic study was made of the sieve products of several hundred sands. It was pointed out that shape and surface of the grains undoubtedly exert an influence on the different properties of sand, such for instance as permeability, bond strength, flowing quality. One cannot determine the formation of the deposit from a study of the texture and grain characters alone. CHL (22)

The Importance of the Foundry Practice in Ship Building. (Die Bedeutung der Giessereitechnik im Schiffsbau.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 22, Mar. 13, 1932, pages 142-143.

The article deals with the casting of heavy parts to be used for ship building. GN (22)

Light-Castings Problems. G. Moran. *Foundry Trade Journal,* Vol. 46, Mar. 31, 1932, pages 201-204.

A general discussion of the problem of the manufacture of light Fe castings. Particular attention is paid to the simplification of molding methods for the production of somewhat complicated castings. OWE (22)

Principles of Mixing and Preparing Molding Sands. (Grundsätzliches über Gattierung und Aufbereitung von Formsand.) A. Rodehueser. *Die Giesserei,* Vol. 19, Apr. 15, 1932, pages 141-145; Apr. 29, 1932, pages 163-168.

Attention is called to the importance of knowing exactly the properties of the used molding sand besides those of the new sand in order to be able to obtain from a mixture of both a molding sand of the required properties. On the basis of analysis of used sand the proportions of old and new sand are discussed according to the purpose, whether for large or small molds, wet or dry casting. The sand should be prepared only after the most favorable mixture of old sand, new sand, carbon and water have been determined; this may lead to appreciable economies in the consumption of new sand. A few examples illustrate the method of selection. Ha (22)

Chaplets and Studs in a Jobbing Foundry. Frank Whitehouse. *Iron & Steel Industry & British Foundryman,* Vol. 5, Mar. 1932, pages 229-230.

Uses for chaplets and studs described. CHL (22)

German Silver Castings of Small Thickness. (Dünnwandiger Neusilberguss.) R. Thews. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Mar. 6, 1932, pages 106-107.

Sound castings of German silver can be obtained only when the melt is properly made. On proper treatment of the melt depends: (1) the uniformity of the structure, (2) the Zn content and the Zn loss, (3) the purity of the casting, and (4) the density of the casting. Of extreme importance is the proper casting temperature. The melting temperatures vary between 1100° and 1300° C. The molding practice to be used is also discussed. In some cases it proved advantageous to re-melt the alloy. GN (22)

FURNACES & FUELS (23)

Manipulation of Electrodes of Electric Steel Furnaces. (Zur Behandlung der Elektroden in Elektrostahlöfen.) THEWS. *Die Metallbörse*, Vol. 21, June 13, 1931, pages 1108-1109.

The wear of electrodes, the significance of water cooling devices and American developments in their design are discussed. EF (23)

Heat Conservation in Iron and Steel Works. H. F. STEINBACH. *Iron & Steel Industry & British Foundryman*, Vol. 5, Dec. 1931, page 128.

The advisability of the recovery of sensible heat in waste gases and of insulating all high-temperature equipment is pointed out. CHL (23)

A New Low-Temperature Furnace. *Automobile Engineer*, Vol. 22, Jan. 1932, page 26.

A brief description is given of a heat-treating furnace designed to operate between 600° to 700° C. The material is placed in a perforated container within the furnace. Uniform temperature is secured by the use of 2 thermo-couples and electric fans to keep the air circulating within the furnace. RHP (23)

Heating Furnaces—Problems Relating to Development of Construction and Operation. (Entwicklungsfragen des Ofenbaues und- betriebes unter besonderer Berücksichtigung der Wärmöfen.) ALFRED SCHACK. *Archiv für Eisenhüttenwesen*, Vol. 5, Oct. 1931, pages 193-208.

Report 155 of Heat Section of Verein deutscher Eisenhüttenleute. New developments in furnace construction and operation are discussed mathematically on the basis of heat efficiency. 21 simple formulae with illustrative problems are given for heat calculations, heat balance, losses, insulation, preheating, thermal efficiency, fuel requirements, furnace performance, fuel-bed resistance, etc. Furnace efficiency may be improved by decreasing heat loss through wall or lining or in stack-gases. Good heat protection is possible only when the refractory brick has a sufficiently high constant pressure-softening point, which is 100° to 200° C. lower than the laboratory pressure-softening point. Sensible gas loss with a given fuel depends on the operating temperature range, the efficiency of heat transfer and the specific amount of waste gases. A large combustion space with correspondingly slow traveling combustion gases will give maximum heat transfer. The amount of waste gases may be kept at a minimum and stack draft kept constant by preventing air leaks. This is especially advantageous in the open hearth furnace. The largest economy in waste gas loss is obtained by avoiding unburned fuel as far as possible; 1% CO gives waste equivalent to and increase of 90° C. in stack-gas temperature. Preheating air gives an exceptionally high amount of heat and causes a drop in stack-gas temperature. With short-flame burners stack-gas temperature decreases more than with long-flame burners. Most efficient heating is obtained if the charge is gradually built up in short time intervals in thin layers. Heating of 2 sides simultaneously is extremely effective; it is possible to decrease the heating period in some cases to ¼ of the heating time for a furnace heated on 1 side. DTR (23)

Some Aspects of the Industrial Gas Problem. G. E. WINDIATE. *Gas World*, Vol. 96, Feb. 20, 1932, *Industrial Gas Supplement*, pages 11-14.

This paper, read before the Manchester and District Junior Gas Association, Preston, Feb. 6, 1932, considers the industrial load of the gas industry and its future possibilities. The application of gas for heating purposes depends on its ease of control, consistency of supply, efficiency, cost and service. Metallurgical uses are discussed. MAB (23)

The Low-Frequency Induction Furnace and its Scope. A. G. ROBIETTE. *Metallurgia*, Vol. 4, Sept. 1931, pages 153-155; Oct. 1931, pages 175-176.

The development of the low frequency induction furnace is discussed. The vertical ring type (Ajax-Wyatt) is the one now generally used. Recent improvement in refractories permits economical melting of Ni-brass and high-Cu alloys in this furnace. It also works admirably for superheating cast Fe and is better suited for brass melting than the arc furnace because it tends to heat the coldest part of the bath. JLG (23)

The Design of Oil-Fired Crucible Furnaces. G. S. WATSON. *Foundry Trade Journal*, Vol. 46, Feb. 18, 1932, pages 117, 120.

The first principles of oil-fired crucible furnace construction are discussed, including design of burner, oil-blast inlet, combustion chamber, metal-preheating chamber and waste-products outlet. OWE (23)

Investigation and Calculation of Nozzle Burners. (Untersuchung und Berechnung von Düsenbrennern.) PAUL RHEINLÄNDER. *Archiv für das Eisenhüttenwesen*, Vol. 5, Feb. 1932, pages 407-411.

Report 159 of Heat Section of Verein deutscher Eisenhüttenleute. The mixing ratio of a burner may be calculated from discharge formula. An equation is derived by which the gas-air ratio of a burner may be calculated from the specific gravity of gas and air and the pressure drops taking place in the nozzle and in the burner head. On the basis of this equation, a simple diagram may be drawn for each burner showing, for a given kind of gas, the gas-air ratio in relation to the pressure in the burner head. DTR (23)

Gas-Fired Muffle Furnaces for Forging and Re-Heating. (Schmiede- und Wärmofen mit Ferngasbeheizung.) H. REPKY. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 13, Feb. 1932, pages 39-41.

The process of combustion with oil and coke-oven gas, including the time required to heat up, the temperature of the hearth and heat load, effect of preheating the air, compression of air, and comparison of operations in the hearth with solid and gaseous fuels are discussed. MAB (23)

The Time Required for Complete Heating of a Specimen in an Industrial Furnace. (Durchwärmezeit von Werkstücken in Industrieöfen.) VICTOR PASCHKIS. *Archiv für Wärmewirtschaft und Dampfkesselwesen*, Vol. 12, Dec. 1931, pages 356-357.

The relationship between the temperature of the heat as it is supplied and as it reaches the specimen is discussed. Diagrams are given which give the differences in temperatures between the surface and the core of a specimen in the furnace under various furnace conditions. MAB (23)

Effect of Oxidation on Caking Properties of Coal. R. V. WHEELER & T. G. WOOLHOUSE. *Fuel in Science & Practice*, Vol. 11, Feb. 1932, pages 44-55.

Presented at Third International Conference on Bituminous Coal, Pittsburgh, Pa., 1931. Includes bibliography, 21 references. The caking properties of coals of low C content (higher O_2 content) are more readily affected by oxidation than are coals of higher C content. Oxidation insufficient to affect ultimate analyses can cause a coal of low C content to lose its caking power almost completely. With increasing C content coals become less readily oxidized, and their caking power is affected only after an appreciable change in ultimate analysis has been effected. Then the yield of oil obtained on carbonization is reduced materially. From analyses of 2 oxidized coals it is suggested that the total O content of a coal is of little value in determining caking power. DTR (23)

The Coreless Induction Furnace. (Der kernlose Induktionsofen.) G. SIMON. *Bergwerk & Hütte*, Vol. 29, Feb. 5, 1932, pages 13-15.

The dimensions, lining, operation, efficiency and advantages of coreless induction furnaces are discussed. GN (23)

Automatic Annealing Furnace. (Selbsttätiger Härteofen.) E. FR. RUSS. *Stahl und Eisen*, Vol. 52, Feb. 18, 1932, pages 172-173.

Operating details are given for the new Russ type heat treating and annealing furnace which is used for annealing steel parts that must meet rigid specification. DTR (23)

Heating Steel for Forging. C. B. PHILLIPS. (Surface Combustion Co.) *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1131-1133, 1142.

The damage done to steel in forging furnaces, consisting of oxidation, decarburizing, local carburizing, overheating, fissuring and burning, is reviewed. Diffusion combustion, properly applied, makes possible control of the atmosphere within the furnace. Air or gas are maintained in separate layers, combustion proceeding only at flame boundaries and no actual mixing taking place except at those boundaries. By causing the lowermost layer of gas to sweep over the work lying on the hearth, the steel can be heated without oxidation. In diffusion combustion, the heat is radiant as a result of the large amounts of fine C particles liberated from the fuel gas. Very rapid rates of heating are obtained, making possible increased production and reduction in the size of the furnace required with very uniform temperature distribution. MS (23)

Corner Firing of Blast Furnace Gas. OTTO DE LORENZI (Combustion Eng. Corp.) *Combustion*, Vol. 3, Jan. 1932, pages 11-16.

The excellent over-all results being obtained with blast furnace gas in modern steam generating units designed for corner firing are described. The gas burners located in the 4 corners of the lower part of the furnace are so directed that fuel streams form tangents to a small imaginary circle lying in the center of the furnace, thus imparting a rotary motion to the mixture and setting up extreme turbulence which produces thorough mixing, thus speeding the combustion process materially, reducing the time required for completing the reaction and reducing furnace volume substantially. DTR (23)

REFRACTORIES & FURNACE MATERIALS (24)

The Specific Heat of Magnesium and Aluminum Oxide at High Temperatures. GORDON B. WILKES. *Journal American Ceramic Society,* Vol. 15, Jan. 1932, pages 72-77.

The mean specific heat of pure Al and Mg oxides has been determined from room temperature up to 1700° and 1800° C., respectively. The specimens were heated in a vertical carbon tube furnace with a magnesite tube liner for oxidizing conditions. A special calorimeter was designed and used to prevent the loss of heat by vaporization of the water when the white hot specimens were immersed. WAT (24)

50 Years Production of Refractories. (50 Jahre Herstellung feuerfester Erzeugnisse). W. STEGER. *Tonindustriezeitung,* Vol. 56, Feb. 11, 1932, pages 184-186; Feb. 15, pages 200-201; Feb. 18, pages 213-214.

The paper reviews the progress of the last 50 years in the production of refractories under the following headings: (A) dressing, (1) drying of clay, (2) crushing, (3) sieves, (4) mixing machines, (B) shaping with special reference to the various types of presses used, (C) drying and (D) burning. GN (24)

Furnace Repairs and the Storing of Refractory Bricks. (Ofenausbesserung und Lagerhaltung feuerfester Formsteine. Gesichtspunkte zur Normung der Steinformate.) E. MAASE. *Feuerfest,* Vol. 7, Feb. 1931, pages 20-25.

Furnaces frequently require repairs to various parts, particularly to those which undergo severe treatment. To order the requisite bricks, etc., from the manufacturer as required would involve a serious loss of time, so that a stock of spares must be carried, and this necessitates the storing of a large assortment of shapes and sizes in order that any emergency may be met promptly. The author discusses the standardization of shapes of refractory bricks from this point of view. WHB (24)

Heat Absorption by Refractories During Operation of Fuel-Fired Furnaces. M. H. MAWHINNEY (Electric Furnace Co.). *Iron Age,* Vol. 128, Dec. 31, 1931, pages 1678-1682, 1708.

Second of a series of 2 articles. After the interior of heating furnace has been brought up to operating temperature, heat requirement/ft.^{2} begins to vary with wall construction. Summarized from the discussion the conclusion may be as follows: (1) In fuel fired furnace for intermittent operation, the fuel required to heat to operating temperature is practically independent of usual wall construction; during operation fuel consumption is affected by refractory design; (2) During operating period, heat to refractories includes that for both radiation and absorption; (3) In a furnace operated continuously for long periods the refractory lining reaches equilibrium and the only loss of heat to refractories is the true radiation; (4) Intermittent operation lowers average heat required by refractories in comparison with a single heat. VSP (24)

Foundry Refractories. JAS. R. ALLAN. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 2, Dec. 1931, pages 569-584.

Standards for furnace refractory shapes and the allowable tolerances in sizes are discussed. CHL (24)

Refractory Coatings and Mortars. (Les enduits et coulis refractaires). L. LITINSKY. *Revue de Metallurgie,* Vol. 28, Sept. 1931, pages 277-502; *Korrosion und Metallschutz,* Vol. 7, July 1931, pages 165-167; Aug. 1931, pages 195-201; Sept. 1931, pages 210-216; Oct. 1931, pages 243-245, 249; *Chemical Trade Journal & Chemical Engineer,* Vol. 90, Jan. 1, 1932, pages 8-9; *Feuerfest-Ofenbau,* Vol. 7, May 1931, pages 65-80.

The value of a protecting refractory coating depends largely besides its composition on the nature of the binder used in it. A good protective coating must form a solid surface capable of withstanding the penetration of the corroding elements and have a good adherence to the base which can be obtained by proper regulation of the expansion coefficients of the base and the coating, which is of a particular importance in high temperature work. The nature of the coating has to be adjusted in accordance with the base supporting it. As the coefficient of dilatation changes in the same type of bricks, both due to the manufacturing methods and the manner in which they are used in the practice, the adjustment of the proper grade of the coating becomes difficult. A large number of compositions and methods is briefly described. 170 references are given. WHB+JDG+EF+JN (24)

Kaolins—Effect of Firing Temperatures on Some of Their Physical Properties. R. A. HEINDL, W. L. PENDERGAST & L. E. MONG. *Bureau of Standards Journal of Research,* Vol. 8, Feb. 1932, *Research Paper* 410, pages 199-215.

Samples of 5 kaolins, representing some of the important world sources, were fired at 8 different temperatures ranging from 1,100° to approximately 1,650° C. The chemical analyses and pyrometric cone equivalents (softening points) were obtained on the raw materials, the thermal expansion, porosity and specific gravity on the fired materials, and the petrographic analyses on both the raw and fired. X-ray diffraction patterns were made of Georgia, North Carolina, and Mexican (dickite) kaolins, mullite, and cristobalite. WAT (24)

The Melting Points of Zirconiumoxide and Hafniumoxide. (Ueber die Schmelzpunkte des Zirkonoxyds und des Hafniumoxyds.) P. CLAUSING. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 204, Feb. 9, 1932, pages 33-39.

The oxides were melted by placing them in holes in a W rod and heating the latter electrically; the temperatures were determined with a pyrometer of Hobborn-Kurlbaum type. The melting points were determined to 2950 ± 20°K for ZrO_2 and 3047 ± 25°K for HfO_2. A comparison with more recent determinations gives a good agreement, but not so with older measurements. 13 references. Ha (24)

Trade Names in the Fields of Refractory Materials. (Markenbezeichnung im Feuerfest-Fach und Ofenbau.) *Feuerfest-Ofenbau,* Vol. 7, Sept. 1931, pages 136-141.

Trade names of all kinds of materials connected with furnace construction and refractory industry of German and International origin are compiled and briefly characterized. EF (24)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Scaling of Carbon Steels at High Temperatures. G. W. AKIMOV. *Transactions of the Central Aero-Hydrodynamical Institute,* No. 90, 1931, 44 pages, 44 illustrations. (In Russian).

Specimens of 0.14, 0.6, 1.12 C steels and 3.5% C cast iron (whether white or gray not given) were heated in an oxidizing atmosphere under varying time and temperature. Using 500° and 800° C. and determining the amount of oxidation by the increase in weight corrected for carbon elimination it was found that the parabolic law is applicable only to the beginning of scaling after which it follows a straight line with a rapid upturn after 35 hours. The speed of decarburization and scale formation is different. On longer heating the ferrite forming the decarburized zone is composed of long radial crystals. Radial structure is produced as the metal to metal contact along radial grain boundaries is prevented by the stream of reaction gases coming from the area of reaction—the boundary between decarburized layer and original metal. Changing the temperatures to 400° and 900° C. showed that under 600° C. decarburization and scaling are the same, between 600° and 850° C. the speed of decarburization sharply increases while above 850° C. the speed of scale formation increases so fast that the decarburized layer totally disappears. A sharp break in the oxidation curve is found between 800° and 850° C. corresponding to the transformation range and showing that speed of oxidation of γ iron is lower. Water vapor in the scaling atmosphere rapidly increases the reaction. Temper color formation was used as a means of determination of scaling qualities of quenched and annealed steels. Quenched steel scales slower than steel which has been annealed. Surface condition has no influence. Deformation strongly affects the uniformity and speed of scaling. (29)

The Change in Resistance of Graphite, Thorium, Titanium and Titanium-Zirconium between 20.4° K. and 1.1° K. W. J. DE HAAS & P. M. VAN ALPHEN. *Proceedings Academy of Science, Amsterdam,* Vol. 34, Jan. 31, 1931, pages 70-74.

Samples about 15 mm. long were prepared from a block of Ceylon graphite, with the principal axis perpendicular to the direction of the current. The change in resistance near the temperature of liquid He was slight. At 1.1° K the value of R/R. was about 0.12 and this remained nearly constant up to 5° K after which it increased gradually to approximately 0.214 at 20.4° K. Measurements on a part of a single crystal of Th indicated that it became supra-conducting at 1.4° K. In the region between 1.4° and 1.9° K the resistance increased gradually until it acquired its normal resistance at the upper temperature. These results differ considerably from those obtained by Meissner for another part of the same crystal. The resistance of Ti falls rapidly from 1.88° to 1.63° K at which temperature it becomes supra-conducting. The resistance of the Ti-Zr solid solution decreased rapidly between 1.63 and 1.12° K at which point it becomes supra-conducting. It is difficult to obtain reproducible results with these metals. WHB+WAT (29)

Heat Resistant Alloys for Boiler and Engine Construction. (Hochhitzebeständige Legierungen für Dampfkessel- und Maschinenbau.) Br. Schulz. *Brennstoff- und Wärmewirtschaft*, Vol. 13, Feb. 1931, pages 26-28.

Considers special steels with low additions of Mo, V and Al as heat-resistant material. Tests on scaling and physical properties carried out at elevated temperatures by the Material Prüfungsamt Dahlem on the following steel are given: 0.14 C, 0.24 Si, 0.34 Mn, 0.72 Cr, 0.21 V. Calls attention to Sicromal of the Vereinigte Stahlwerke, employing only 6 Cr instead of 15 Cr, with an addition of 0.9-3% Al. Properties of the following representative steel are presented: 0.06 C, 0.3 Mn, 0.4 Si, 0.9 Al, 5.8 Cr, 0.4 Mo and 0.05 V. Tests of Wiburg on 7 different heat-resistant steels are reviewed including low C (0.5-0.15% C), martensitic and austenitic steels and the 2 Heraeus alloys B-7-M with 15 Cr, 61 Ni, 7 Mo, 15 Fe, 2 Mn and Grade B with 15 Cr, 64 Ni, 20 Fe, 1 Mn. The Krupp steels of martensitic (V-M) and austenitic structure (V-A, NCT, FF) are discussed and practical experiences with V-steel, the surface of which is enriched in Al, are given. In conclusion the present state of heat-resistant material used for turbine blades is considered. EF (29)

Alloys of Iron, Manganese and Carbon. Francis M. Walters, Jr., Cyril Wells, M. Gensamer & J. F. Eckel. *Transactions American Society for Steel Treating*, Vol. 19, May 1932, pages 577-623.

See *Metals & Alloys*, Vol. 2, Nov. 1931, page 283. WLC (29)

Pipe Welding for a High Pressure Steam Power Plant. E. B. Severs & W. P. Gavit. *Journal American Welding Society*, Vol. 11, May 1932, pages 10-12.

Paper presented at the Annual Meeting of the American Welding Society in New York, Apr. 1932. Welding offers a solution of the high pressure, high temperature pipe joint problem. The author describes procedure used in welding piping for a boiler and turbine installation operating at 730 lbs./in.² pressure and a temperature of 860° F. TEJ (29)

Impact Characteristics of Steel Rails at Low Temperatures. J. F. Cunningham & J. Gilchrist. *Transactions American Society for Steel Treating*, Vol. 19, May 1932, pages 624-638.

See *Metals & Alloys*, Vol. 2, Dec. 1931, page 325. WLC (29)

Considerations and Tests for Cast Materials for High-Temperature High-Pressure Service. L. W. Spring. *Transactions & Bulletin American Foundrymen's Association*, Vol. 2, Oct. 1931, pages 13-55.

The author points out that castings have certain inherent qualities which other materials, seemingly, do not possess. They are more resistant to "creep" at temperatures above the strain hardening range than wrought materials of identical composition. A large number of short and long time tensile test results are given on cast and wrought materials. Other considerations, which influence the development of high temperature high-pressure service materials are discussed. See also *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 26. CHL (29)

Use of Metals at Elevated Temperatures. Clyde E. Williams. *Brick & Clay Record*, Vol. 80, Apr. 1932, pages 195-197.

The heat resistance requirements for metals used in kilns, dryers and fans are outlined. The types of metals used for the various requirements and the protective measures taken are discussed. See also *Metals & Alloys*, Vol. 2, Sept. 1931, page 192. CBJ (29)

The Properties of Copper in Relation to Low Stresses. The Effect of Cold-Work, Heat-Treatment, and Composition. Part II.—Creep Tests at 300°C. and 350°C. of Arsenical Copper and Silver-Arsenical Copper. H. J. Tapsell & A. E. Johnson. *Institute of Metals, Advance Copy* No. 599, Apr. 1932, 6 pages.

Creep tests were made on 2 alloy coppers. One contained 0.34% As and no Ag. The other contained 0.31% As and 0.072% Ag. They were both given the pre-treatment described in Part I, which consists in cold working to a reduction of about 5% followed by an anneal at 300° or 350° C. It was found that the pre-treatment improved the resistance to creep at 300° and 350° C. and that the Ag-bearing Cu was superior to the Ag-free material. 2 references. JLG (29)

Materials but Little Subject to Aging Phenomena, for the Construction of Boilers (Gering alterungsempfindliche Kesselbaustoffe). *Wärme*, Vol. 54, Jan. 3, 1931, pages 6-7; *Chemie et Industrie*, Vol. 25, June 1931, page 1386.

Izett steel is claimed to be practically not subject to aging phenomena. Alloy steels (particularly 3-5% Ni steels, low C steels containing V or Mo, 0.6-0.8% Cu steel containing 0.4-3% Cr) stand up well against both corrosion and high temperature. This permits of the reduction of the thickness of the boiler shell, thus improving heat transmission which compensates for the extra cost. The steel can be tested by aging artificially by 10% cold stretching, followed immediately by annealing 30 min. at 200° C. WHB (29)

Material Problems Involved in Radiation Super-Heaters. (Die Materialfrage bei Strahlungsüberhitzern.) K. Adloff. *Die Röhrenindustrie*, Vol. 24, Mar. 12, 1932, pages 61-62.

After reviewing recent trends in super-heater designs and the requirements to be met with by materials employed, tests in the Power Station Klingenberg are reported on super-heater tubes. At first Izett steel of 36 kg./mm.² tensile strength and 25% elongation was used. The wall thickness of the tubes was 6 mm. After 635 hours service, the tubes were warped to such an extent, that they had to be exchanged. Then open hearth steel of 41 kg./mm.² and 25% elongation was employed, the wall thickness of the tubes being 4.5 mm. Only tubes which were shielded by cast plates withstood the strain. Now a 6% Cr, 0.4% Mo steel of 50-55 kg./mm.² is selected. It has not been decided yet whether or not continuous operation is possible with wall temperatures above 550° C. The stresses in these super-heater units are discussed. The satisfactory solution of this problem is up to the metallurgist. High alloy steels permit a wall size reduction of about 25% and diminish the critical stresses caused by the great differences in temperature between the inside and outside of the tubes. EF (29)

Further Data on the Thermal Diffusivity of Nickel. Richard H. Frazier. *Physical Review*, Vol. 40, May 1932, pages 592-595.

Results are given of tests for determining the thermal diffusivity of 99.25% Ni. The work is part of a program of thermal measurements aimed toward the measurement of the Thomson effect. The results and conditions of the test are discussed. WAT (29)

little influence on endurance. No information on endurance of notched specimens or on corrosion-fatigue of copper containing additions, are on record.

No accelerated endurance test for non-ferrous metals and alloys has yet been found to give fully reliable data. The tests should run to 100 million cycles or at least to 50 million plus further test at an increased stress to show whether damage or improvement has occurred. Especially on cold-worked material, tests of one form and temper, e. g., sheet, do not necessarily give valid information for other forms and tempers.

Much more work of a very tedious nature is necessary to clarify the engineering problems involved.

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Manufacturers' Literature Reviews

466 **Structural Aluminum**—A supplement to their Structural Aluminum Handbook has been issued by the Aluminum Company of America, Pittsburgh, Pa. It contains additions to the tables in the Handbook as well as new data which were not available at the time the Handbook was published.

467 **Wrought Pipe**—A leaflet recently issued by the National Tube Co., Pittsburgh, Pa., lists ten points of superiority of their pipe, among them being its strength, ductility, uniformity, freedom from scale, etc. Their galvanized pipe is given a special chromate treatment to resist discoloration and the formation of white rust.

468 **Nickel Steel**—The July issue of *Nickel Steel Topics*, published by the International Nickel Co., New York, N. Y., features an article describing the use of nickel steel in free wheeling units for automobiles. A number of applications of this steel to oil well equipment are also illustrated.

469 **Heating and Cooling Wire**—Bulletin 339 of the W. S. Rockwell Co., New York, N. Y., is a reprint of a paper presented to The Wire Association on the Methods of Heating and Cooling Wire. It is a very thorough discussion of this subject and is well illustrated.

470 **Welded Tubing**—The Carpenter Steel Co., New York, N. Y., has sent out a leaflet devoted to their welded tubing made from cold rolled stainless strip steel. The leaflet includes general information on this tubing, its physical properties and working instructions.

471 **Welding**—The August issue of *Oxy-Acetylene Tips*, published by the Linde Air Products Co., New York, N. Y., features an article entitled "Oxwelding Brass and Bronze." Another article in the same issue is "A Simple Cost System for the Repair Shop." The feature article in the September issue is "Economy for the Beet Sugar Industry."

472 **Blooming Mill Equipment**—Bulletin A-701 of the United Engineering & Foundry Co., Pittsburgh, Pa., is a 35-page, fully illustrated booklet discussing their blooming mill equipment for all duties where a large mass of metal is to be roughed down rapidly for finishing to smaller shapes.

473 **Nickel-Clad Steel**—A booklet just published by the Lukens Steel Co., Coatesville, Pa., illustrates various applications of nickel-clad steel in chemical and industrial processing equipment, in the textile industry and in general industrial service.

474 **Shield-Arc Welder**—A bulletin just released by the Lincoln Electric Co., Cleveland, Ohio, describes their new "Shield-Arc" welder which makes possible improved quality and speed of welding.

475 **Foundry Equipment**—Catalog No. 540 of the Jeffrey Manufacturing Co., Columbus, Ohio, describes and illustrates how various types of foundries have been modernized by the installation of Jeffrey foundry machinery. Typical arrangements of equipments are pictured by perspective drawings. The kinds of equipment discussed include continuous core handling equipment, trolley conveyors, crushing and pulverizing equipment, sand mixers and sand conditioners.

476 **Tensometers**—Bulletin 37 of the Baldwin-Southwark Corp., Philadelphia, Pa., covers their line of lever type strain gages known as Huggenberger Tensometers. A short technical discussion of the fundamental principles of these instruments is followed by data and suggestions concerning application of the various types of Tensometers. A section describing the methods of mounting and using Tensometers is included. Bulletin 40 published by the same company describes their Scratch Extensometer which weighs less than an ounce, is hardly larger than a teaspoon, may be attached to light as well as heavy structures, is recording and can be purchased for less than $50.

477 **Portable Hardness-Testing Instruments**—Bulletin No. H-4 of the R. Y. Ferner Co., Washington, D. C., describes the Duroskop and the dwarf Brinell press. The former can be used for testing many materials, from tempered steel to refined lead, as well as linoleum, rubber, wood, etc. The latter may be used for all testing done with the larger Brinell instruments with the added feature that it is portable.

478 **Nickel-Clad Steel Plate**—Bulletin T-4 sent out by the International Nickel Co., New York, N. Y., is entitled "Methods for the Fabrication of Nickel-Clad Steel Plate." Full information on the subject is given. The bulletin was prepared by their research department and is one of their technical bulletin series.

479 **Automatic Temperature Control**—Bulletin 177 sent out by the Foxboro Co., Foxboro, Mass., is entitled "Temperature Controllers" and gives a complete description of the operating principles of their controllers together with construction features. The various types are illustrated and described and each part of the controller is discussed at length.

480 **Liquitol**—Several leaflets have been issued by the Alpha-Lux Co., Inc., New York, N. Y., which pertain to their "Liquitol" which is to be used in the production of iron and steel castings and steel ingots. It is a fine black powder which is sprinkled over the surfaces of the molten metal in the heads and runners.

481 **Testing Precious Metals with the Touchstone**—An attractive booklet of this title has just been prepared by the Jewelers' Technical Advice Co., 22 Albany St., New York, N. Y. It comprises a succinct but exhaustive text on practical testing of the precious metals. The methods described have been thoroughly tested and are simple but effective. Price $1.00.

482 **Thermometers**—Catalog 1204 of the Bristol Co., Waterbury, Conn., is devoted to their vapor tension type thermometers. It is intended to be not only a summary of these instruments as made by them, but a handbook of reference for those engaged in specifying or recommending recording and controlling instruments.

483 **Tempering Spring Washers**—A leaflet issued by Leeds & Northrup Co., Philadelphia, Pa., describes the installation of five Homo tempering furnaces used by the National Lock Washer Co. Another leaflet by the same company describes Homo tempering for parts and tools and Hump hardening as used by an instrument manufacturer.

484 **Manganese Bronze**—The July issue of *Better Castings*, published by the Niagara Falls Smelting & Refining Corp., Buffalo, N. Y., gives instructions for making manganese bronze with "Falls" No. 21 manganese bronze hardener. The procedure using new metals and new metals with scrap is detailed.

485 **Electric Furnaces**—The Pittsburgh Electric Furnace Corp., Pittsburgh, Pa., is distributing reprints of "Duplexing With Cupola Makes High Grade Iron Castings" which appeared in *Iron Age*.

486 **Gas-Electric Sets**—Publication C 1959 of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes and illustrates gas-electric sets, listing their mechanical features, ignition and control. They are designed for furnishing continuous or auxiliary power supply for mines, barges, dredges, oil and gas wells, etc.

487 **Bunsen Spectroscope**—A leaflet recently sent out by Bausch & Lomb Optical Co., Rochester, N. Y., describes the construction of their Bunsen spectroscope designed for the use of teachers. Mention is also made of their laboratory wave length spectrometer.

488 **Superheaters**—Bulletin T-22 of the Superheater Co., 60 East 42nd St., New York, N. Y., discusses the Elesco superheaters for horizontal return tubular boilers. A table shows results of tests in a plant using these superheaters.

489 **Nickel Alloy Steel Castings**—Bulletin No. 8-A of the International Nickel Co., New York, N. Y., discusses the applications of nickel steel castings, the design of these castings, the effect of alloying elements on cast steels, the methods of adding alloys to steel and the heat treatment of the castings. The pamphlet is one of their Nickel Steel Data and Applications Series.

490 **Furnaces**—Bulletin 333 of the W. S. Rockwell Co., New York, N. Y., is devoted to their belt-conveyor type continuous furnaces, both electric and fuel-fired. Bulletin 334 of the same company gives data on their non-ferrous billet heating furnace.

491 **Oilstones and Sharpening Stones**—A leaflet prepared by the Pike Manufacturing Co., Pike, N. H., shows their different powered oilstones and the method of using them for various tools.

492 **Brazing Alloy**—Bulletin No. 7 of Handy & Harman, New York, N. Y., describes their Sil-Fos, a low melting point brazing alloy which makes strong, sound, corrosion-resisting joints on copper, brass, bronze, nickel, Monel metal and other non-ferrous metals or alloys.

493 **Sodium Perborate**—The Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y., have published a 16-page booklet entitled "Properties and Uses of R & H Sodium Perborate." The presence of 1/20 to 1/50 oz. of this chemical per gallon of nickel plating solutions stops hydrogen pitting, according to this booklet. In the alkaline tin bath and sulphate zinc bath, pleasing white plate is produced through the presence of small amounts of sodium perborate in the plating solution.

494 **Smoke Recorder**—The application of the Micromax potentiometer for this purpose is discussed in a folder prepared by Leeds & Northrup Co., Philadelphia, Pa.

495 **Fuel Governor**—A leaflet describing an engine governor with remote setting for speed has been sent out by the Pickering Governor Co., Portland, Conn.

496 **Motorized Speed Reducer**—The Link-Belt Co., Chicago, Ill., has recently sent out a leaflet announcing a new motorized speed reducer which has been added to their line. The reducer illustrated is a triple reduction unit with a speed ratio of 312.2 to 1. The motor shaft operates at 1165 r.p.m., and the low speed shaft at only 3.75 r.p.m.

497 **Chromium Plating**—The August 1932 issue of *The Udylite News*, published by the Udylite Process Co., Detroit, Mich., features an article on Udylite as applied to the manufacture of radio condensers.

498 **Graphic Meters**—Bulletin No. 4321 of the Esterline-Angus Co., Indianapolis, Ind., contains an article entitled "Determining the Cost of Power and the Maximum Load Conditions Throughout a System." Bulletin 12302 of the same company describes the reactive volt ampere meter and its uses on the power system while bulletin 1227 is devoted to their frequency meter.

499 **Diesel Electric Locomotives**—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has published an illustrated folder describing the use of Diesel electric locomotives in the steel industry and covering the economies effected thereby. Folder DMF-5449.

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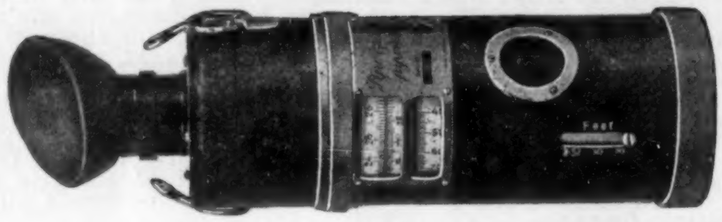

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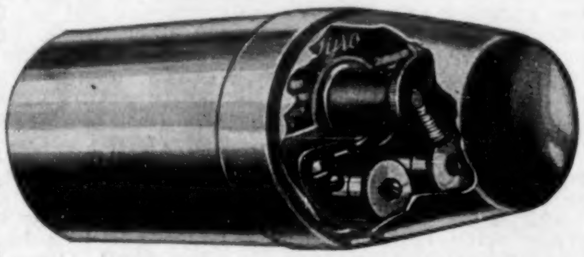

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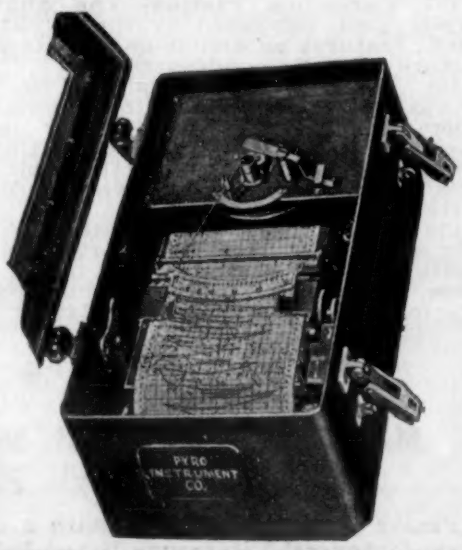

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Basic Principles of Metallurgy Discussed by Steel Treaters. Part II, Part III. *Fuels & Furnaces*, Vol. 9, Nov. 1931, pages 1295-1299; Dec. 1931, pages 1407-1412.

Presents abstracts of lectures delivered to young men without technical education as part of a course sponsored by the Pittsburgh Chapter of the American Society for Steel Treating. S. L. Goodale discusses metallurgical terms, crystallization and metal structures, structures and properties of pure metals and hot and cold working. Norman Woldman discusses the Fe-C diagram and straight C steels. N. I. Stotz describes heat treating operations and J. A. Succop deals with mechanical shaping of metals. V. N. Krivobok discusses alloy steels other than high-speed and stainless steels and structures and properties of alloys. MS (0)

The Joy of Ignorance. T. SWANN HARDING. William Godwin, Inc., New York, 1932. Cloth 6 × 9 inches, 369 pages. Price $3.00.

This book will make much of your bliss evaporate. Harding decided to investigate the fallacies and fictions promoted by popular slogans and the nostrums endorsed by plausible quacks.

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You will probably save money and be more comfortable without your bogies and superstitions. Harding's book is a mental disinfectant and provides enjoyable reading.
Richard Rimbach (0) -B-

Specifications for Quality Metals, How to Write Them. F. M. RANDLETT. *Metal Progress*, Vol. 21, May 1932, pages 44-45.

In drawing a specification a minimum number of requirements consistent with a satisfactory product should be included. The wording should be without ambiguity and should provide for inspection and tests for the protection of the consumer. WLC (0)

Metallurgical Developments in 1931. T. M. SERVICE. *Iron & Coal Trades Review*, Vol. 124, Jan. 22, 1932, pages 154-155.

The research carried out in England and elsewhere on the heterogeneity of steel, the solidification and crystallization of steel ingots, balanced reactions in steel manufacture, corrosion of iron and steel, and the behavior of steel under stress at high temperature is briefly reviewed. Ha (0)

Research and Development in Metallurgy. C. E. MACQUIGG. *Journal Franklin Institute*, Vol. 213, June 1932, pages 583-604.

Brief survey of research and development in metallurgy stressing the commercial aspects, and discussion based on conditions in the U. S. The first tensile strength in 1837 was determined by transverse tests. Tensile strength, ductility, hardness, resilience, electrical properties, behavior toward corroding media, fatigue, are the qualities of metals and alloys about which information is generally sought. The purpose of metallurgical progress is at least 3-fold, namely: (1) to cheapen or otherwise improve the processes for obtaining metals from their natural state or to discover new processes; (2) to obtain metals or their combinations that will serve in applications or new needs of industry in which existing materials, partly or wholly inacceptable, and to improve the qualities of metals and their alloys; (3) to multiply the uses to which the present products can be legitimately applied. Mention is made of new tests and applications such as "creep," shock testing, X-ray, metallographic tests, light alloys, new steel alloys, corrosion resistant steels, etc. 28 references. DTR (0)

Modern Tendencies Regarding the Methods of Study of Metals and their Alloys (1928-1930). (Les tendences récentes relatives aux méthodes d'étude des métaux et de leur alliages [1928-1930].) LÉON DLOUGATCH. *Revue de Métallurgie*, Vol. 29, Apr. 1932, pages 215-220; May 1932, pages 276-279.

A brief survey of the tendencies, which can be observed in the world's work on metals and their alloys as far as the methods of study are concerned. JDG (0)

Steel Control (Die Stahlkontrolle). R. ESCHELBACH. *Die Werkzeugmaschine*, Vol. 36, Mar. 31, 1932, pages 99-102; Apr. 15, 1932, pages 124-126.

Report from the Metallographic Institute of the Mining Academy at Clausthal, Germany. The article gives a detailed description of how the production of a German quality steel mill is controlled in order to process products of high quality. The points dealt with in particular are supervision of the casting temperature of the ingots, supervision of the rolling temperature, data are given on the most suitable rolling temperatures for the various types of steel, supervision of forging with data on suitable forging temperatures, methods of control of the various steels in heat treating. The procedure is outlined for alloy and plain case carburizing steels, Cr structural steels, tool steels, high speed steels. The spark test and mechanical testing are emphasized. GN (0)

PROPERTIES OF METALS (1)

The Changes of Electric Conductivity of Ferromagnetic Materials in Magnetic Fields (Die Aenderungen der elektrischen Leitfähigkeit ferromagnetischer Stoffe in Magnetfeldern). O. Stierstadt. *Zeitschrift für Technische Physik,* Vol. 13, No. 3, 1932, pages 105-111; No. 4, 1932, pages 161-165.

Ferromagnetic phenomena are discussed in the light of the newest theories of Sommerfeld, Fermi-Dirac, Weiss and others. For the details of the exhaustive investigation the paper must be referred to. The general conclusions are as follows: The change of resistance of all metals including ferromagnetics is, at sufficiently low temperatures, always positive, both in longitudinal and in transverse magnetic fields. All anomalies are explained and it is found that the sign of the induced magnetism in a metal is not a question of the direction but of the strength of the magnetizing field. Also the sign of the change of resistance of ferromagnetic materials in magnetic fields is explained by the theory; at room temperature it is positive in weak longitudinal fields, negative in strong transverse fields. The opposite conditions will not be sufficiently clear until further measurements have been made. The influence of temperature is also still to be determined more exactly. 20 references. Ha (1)

Beryllium and Beryl. Official publication, the Imperial Institute. His Majesty's Stationery Office, London, 1931. Paper, 26 pages. Price 6d.

Brief summary of properties of metallic Be, methods of production, alloys, compounds, deposits of beryl in various countries. A bibliography is appended. Cu-Be alloys are suggested for springs and bearings. Bearings with 1 to 2% Be are said to show less wear than those of Sn bronzes. Much of the data in the pamphlet is elsewhere available. HWG (1)

Useful Information About Lead. Lead Industries Association, 420 Lexington Ave., New York, 1931. Cloth, 6 × 9 inches, 104 pages. Price 50 cents.

This publication describes concisely the story of Pb and its principal uses. Short chapters are devoted to the major industries consuming Pb, and the part Pb plays in them, as well as the history, mining, smelting and refining of the metal. The table of the properties of Pb is probably the most complete and up to date ever published. The lead compounds are dealt with to some extent in regard to their characteristics, manufacture and uses. Many corrosive chemicals handled in Pb equipment are listed and typical formulae of important classes of alloys are given. WAT (1) -B-

Molybdenum, the Metal that Talks. *Electrical Engineering,* Vol. 51, May 1932, pages 311-312.

A brief description of the uses of the metal in recent times, its deposits and production from ores and prospective further applications. In steel it can be substituted for W in a ratio of 1:2; use of the high strength of Cr-Mo steel is made in steel tubing. The pure metal is used extensively in the incandescent and radio bulb industry. It finds use also in the chemical and dye industry. Ha (1)

Tantalum and Its Applications. (Le tantale et ses applications.) L. Triau. *Aciers Spéciaux, Métaux et Alliages,* Vol. 7, Jan. 1932, pages 15-17.

History of the discovery and isolation of Ta. Its uses and properties are also reviewed. Its chief property is its resistance to corrosion by acids or alkalies. GTM (1)

Studies of Italian Aluminum. (Richerche sull' alluminio Italiano.) O. Scarpa. *Alluminio,* Vol. 1, Jan.-Feb. 1932, pages 3-14; Mar.-Apr. 1932, pages 73-79.

Italian Al for electrical conductors is stated to run 99.5-99.7% Al, with Fe from .10 to .30, Si .10 to .15, Ti trace to .10. Conductivity tests on 342 samples of wire showed resistance at 20° C. from 2.79 to 2.93 microhms/cm, with about 4% falling below 2.82 and about 5% above 2.89. The average is about 2.845. A frequency curve of resistivity shows about the same form as one for foreign Al. The density of Al wire, reduced to H_2O at 4° C. ran from 2.703 to 2.707. Part II. The effect of annealing on the electrical conductivity, strength and density of wire made from Italian Al was found to agree with results on Al conductor wire in general. Curves are plotted for resistivity and for tensile strength vs. annealing temperatures (4 hr. anneals). A frequency curve for decrease in resistivity on annealing shows a maximum at 2.25% decrease, but the curve is not symmetrical, perhaps 20% of the specimens showing 3.0 to 3.7% decrease, while with a symmetrical curve, there would have been none above 3%. HWG (1)

Theory of Metals. I. Proper Values and Proper Functions of the Linear Atomic Chain. (Zur Theorie der Metalle. I. Eigenwerte und Eigenfunktionen der linearen Atomkette.) H. Bethe. *Zeitschrift für Physik,* Vol. 71, Aug. 15, 1931, pages 205-206.

A theoretical treatment showing how the proper functions of zero approximation and the proper values of first approximation can be calculated. Ha (1)

Magnetostriction Measurements using a Heterodyne Heat Method. A. B. Bryan & C. W. Heaps. *Physical Review,* Vol. 37, Apr. 1931, pages 466-467.

The changes of length in a longitudinal magnetic field were measured of crystals of Ni, Fe, magnetite and hematite and Bi. Former measurements of Ni and Fe were confirmed, magnetite expands in 2 directions and contracts in the third, hematite shows a slight expansion, while Bi does not show any change at all even for fields higher than 2000 gauss. Ha (1)

Molybdenum. Alice V. Petar. *United States Bureau of Mines Economic Paper* 15, 1932, 38 pages.

The properties; uses; occurrence; mining, milling and manufacturing methods; foreign and domestic production, markets, etc. for Mo are discussed. An extensive bibliography is given. AHE (1)

The Search for New Alloys. Leland D. Case. *Rotarian,* Vol. 40, May 1932, pages 26-28, 52-54.

The process of making Mg metal from Epsom salts is briefly described and the uses of Mg alloys and their characteristics, especially for airplanes, because of their extreme lightness are explained. Ha (1)

PROPERTIES OF FERROUS ALLOYS (3)

Tool Steels (Les Aciers D'outillage). J. Laymarie. *Aciers Spéciaux, Métaux et Alliages,* Vol. 7, Feb. 1932, pages 69-77.

A general review and classification of tool steels. GTM (3)

The Effect of Annealing on the Mechanical and Magnetic Properties and Electrical Conductivity of Cold Drawn Steel. (Ueber den Einfluss des Anlassens auf die mechanischen und magnetischen Eigenschaften sowie die elektrische Leitfähigkeit kaltgezogenen Stahles.) Werner Köster & Herbert Tiemann. *Archiv für das Eisenhüttenwesen,* Vol. 5, May 1932, pages 579-586.

Tests made on 7 steels, C running between 0.03 and 0.95%. The Si was below 0.2%, Mn between 0.3 and 0.7% and P + S was less than 0.035%. Steel wires 5.3 mm. diam., in both annealed and patented state, were drawn cold and given 0, 20, 50 and 80% cold roll reduction. After being drawn the wires were stored for about one month, and then the mechanical, magnetic and electrical properties were studied after annealing up to temperatures 950° C. The rise of the yield point and tensile strength between 200° and 300° C. was greater for patented steel than for annealed material; these properties were apparently independent of amount of cold roll reduction and increased with increasing C content. For high C-steel with 80% cold roll reduction, the elongation begins to drop at 450° C. and reaches a definite minimum value at 525° C. The reason for this decrease in elongation lies in the distinctive rate of decrease in yield point and tensile strength. The resistance to compression of patented steel reaches a minimum between 450° and 500° C., and then rises with greater cold roll reduction and higher % C. This characteristic appears to be a simple weakening process, the reverse of this taking place when the steel is later cold drawn. The drop in coercive force on annealing is retarded in the temperature range between 400° and 550° C. and the more so the greater the amount of drawing and the higher the carbonization of the steel. The retarding finally changes over into an increase of coercive force. Patented steel shows this phenomenon even much more than annealed material. It is attributed to the fine small-pointed distribution of cementite within these temperature limits. The remanence rises regularly with the annealing temperature. The rise begins and ends with increasing change in form at low temperatures, and the maximum value of remanence rises in the same direction. The electrical conductivity rises on annealing above 400° C. and reaches a maximum at 550° to 680° C. After passing beyond the A_1 point, the conductivity drops back to its initial value. The rise is attributed to the conversion of cementite from the laminated into the spherical shape. 19 diagrams and 9 references. DTR (3)

Manganese Steel, Its Structure and Properties (L'acciaio al manganese, sua struttura e proprieta). G. Guzzoni. *La Metallurgia Italiana,* Vol. 24, Mar. 1932, pages 173-186.

32 references. Evidence is presented that, in the austenitic Hadfield steel, heating to below the Ac_1 point tends to produce first precipitation of carbide, then (following the impoverishment of the matrix in Mn and C) the formation of troostite. Further heating above Ac_1 produces further precipitation of carbide. The formation of troostite is direct, not through martensite, and the common terminology by which the decomposition product of austenite in these steels is termed martensite, has arisen through the acicular structure of the carbide needles. The mechanical properties of the steels are better with lower C and higher Mn; 0.85-0.95% C and 12-14% Mn gives better results than 1.0-1.35% C. 11.5-12% Mn. Resistance to abrasion is best with a pure austenitic structure. It falls if the austentite has started to decompose. Interesting micrographs are shown of an Amsler wear-test specimen whose cold-worked surface shows slip lines. After heating 3 hours at 600° C. precipitation occurred along the slip lines while in a similarly heated, un-worked specimen, precipitation was along the grain boundaries. See also *Metals & Alloys,* Vol. 3, July 1932, page MA 197. HWG (3)

Production and Properties of Superior Cast Iron. Oliver Smalley. *Metal Progress,* Vol. 21, May 1932, pages 49-54.

The author describes the properties of high strength cast irons made by addition of large amounts of steel to the charge and the addition of measured amounts of calcium silicide in the ladle. Such modern irons show good elastic properties compared to other cast materials and weld metal. Castings are sound and of uniform hardness with thin plate graphite uniformly distributed in a matrix of eutectoid steel which is capable of property development by heat treatments the same as steel. Applications are discussed. WLC (3)

Non-Rusting and Heat Resistant Chromium-Cast Iron Alloys. (Ueber nichtrostende und hitzebeständige Chrom-Gusseisen-Legierungen.) R. Wasmuht. *Stahl und Eisen,* Vol. 52, Apr. 7, 1932, pages 346-347.

Originally published in *Kruppsche Mh.* 12 (1931) pages 331-337. Cast iron alloys with Cr above 30%, and C between 1 and 4% were studied. Ledeburite was present with 1% C. With 2%C and 34% Cr the cast iron was weakly subeutectic, and with 3% C, Cr-cementite $(CrFe)_7C_3$ had precipitated out. Eutectic was at 2.4% C. Corrosion resistance of these low C-cast iron alloys was practically similar to that of non-rusting steels. Alloys show characteristic cast iron behavior. Breaking strength 40-50 kg./mm.^{2}, Brinell hardness 250 to 350, depending on C-content. Several tests were made on strength at high temperatures, shrinkage, sp.gr., etc. Several examples of machining and welding of alloys are included. DTR (3)

Stainless Steels—Their Fabrication and Welding. W. Thompson. *Welding Journal,* Vol. 29, Mar. 1932, pages 77-79; discussion, Apr. 1932, pages 109-111.

Paper read before the members of the Midlands Branch of the Institution of Welding Engineers (Birmingham) Jan. 15, 1932. The author classifies and describes the various types of stainless steels, giving general compositions and properties. The 18-8 composition is discussed somewhat in detail. Also includes information on preparation for welding, oxy-acetylene, atomic hydrogen and metallic arc welding and a discussion of weld decay. TEJ (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Commercial Corrosion Occurrences, Their Causes and Prevention. (Korrosionsbeispiele aus der Praxis, ihre Ursache und Vermeidung.) K. Mandl. *Korrosion und Metallschutz*, Vol. 8, Jan. 1932, page 15.

Al gaskets for wrought iron pipe flanges of NH_3-plants failed in service. Instead of a metallic jacket an asbestos one should be employed. The corrosion of Al coils of cooling systems is explained by the occurrence of potential differences, and the analogy to the failure of Fe condenser pipes is pointed out. Preventive means such as galvanizing, cathodic treatment of Fe and dense lacquer coatings are recommended. The corrosion of Pb-coated roofings due to SO_2 is ascribed to the formation of local elements. An intermediate layer of Sn is urged. The corrosion of cast iron parts of paper pulp pumps can be eliminated by employing V2A steel or acid proof bronze. EF (4)

Corrosion of Ship Plates. J. Montgomery & W. E. Lewis. *Iron & Coal Trades Review*, Vol. 124, Feb. 26, 1932, page 357.

As a result of observations over a considerable period of time the conclusion is drawn that the problem of corrosion on the external surface of merchant vessels is primarily connected with the condition of the surface in respect to the amount of mill scale still adhering to them before the paint is applied. The best method of maintaining steel structures free from corrosion is, therefore, the thorough cleaning of the surfaces, including the removal of mill scale, and efficient painting thereafter. Ha (4)

Types of Rust Formation. (Die Arten der Rostbildung.) G. Chaudron. *Oberflächentechnik*, Vol. 9, Apr. 19, 1932, pages 78-79.

Starting from the fact that rust is started by the corrosion of wet Fe the local elements which form on the metal surface in certain salt solutions are seen as the cause of the corrosion. The different physical and chemical conditions which promote or delay rust formation are briefly discussed and the chemical changes which lead to rust forming oxide are explained. The efficacy of protective coatings by preventing the formation of local elements is briefly discussed. Ha (4)

On the Passivity of Chromium. (Zur Passivität des Chroms.) W. J. Müller. *Zeitschrift für Elektrochemie*, Vol. 37, June 1931, pages 328-330.

The author replies to the discussion and criticism of his previous papers on the passivity of Cr, and comments on the conclusions reached by E. Müller and others. He maintains that the theory developed by him and Essen satisfactorily explains the behavior of different acids in the activation of passive Cr. Ha (4)

The Topo-Chemistry of Corrosion and Passivity. II. Investigation of the Primary Corrosion Effect on Soft Iron. (Zur Topochemie der Korrosion und Passivität. II. Untersuchung des Primäraktes der Korrosion und Weicheisen.) E. Pietsch, B. Grosse-Eggebrecht & W. Roman. (Technische Hochschule Berlin). *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 157, Dec. 1931, pages 363-368.

Corrosion tests were performed with Krupp's soft iron (0.05% C, 0.06% Si, 0.08% Mn, 0.01% P, 0.01% S). 2 sets of experiments were carried out in which material with the same grain size but different preliminary treatment was used: (a) one set was annealed in the γ range; (b) the other group of samples was strain-hardened and recrystallized below A_1. The solution media employed were as follows: (1) H_2O_2 of various concentrations and with and without additions of different acids; (2) boiled out distilled water; (3) 1.6% aqueous NaI solution; (4) ½ *N* acetic acid, 1 *N* butyric acid, 1 *N* valeric acid, i. e. aqueous solutions of acids with increasing number of C atoms; (5) 1/10 *N* HCl. The systematic tests with these solutions permit the conclusion that the primary effect of corrosion consists in the adsorption of the attacking medium on the grain borders or similar linear discontinuities (for instance pipes, scratches, border lines of metal), indifferent substance of high surface tension. The formation of rust and the passification is explained by quantum-mechanic considerations. All tests and the test results are reproduced in full. Ha+EF (4)

Experiences with High-Pressure Boiler Plants. Marguerre. *Engineering*, Vol. 132, Aug. 28, 1931, pages 267-271.

Same as article in *Power*, Vol. 74, Oct. 13, 1931, pages 542-543. AHE (4)

The Corrosion Committee, Water Section, of the DVGW. The Question of Corrosion. (Aus dem Ausschuss "Korrosionsfragen" der Abteilung Wasser des DVGW. Zur Korrosionsfrage.) Thiesing. *Das Gas- und Wasserfach*, Vol. 75, Apr. 2, 1932, pages 253-255.

A general discussion of the present status of work on corrosion done by the Committee. The author considers the various theories of corrosion, the causes, the effects on different metals, the effect of the composition of the water, and the effects of fatigue, working of metals, etc., on the corrosive attack. MAB (4)

Solubility Studies of Boiler Water. Frederick G. Straub. *Combustion*, Vol. 3, Apr. 1932, pages 12-16.

Over 2000 separate solubility tests have been made to determine solubility data at higher temperatures and pressures. This data is to be used in determining causes of scale formation and methods of prevention. Data were taken over a range of temperatures corresponding to pressures 150 to 1500 lbs. gage. This investigation was undertaken due to failure of water wall tube of a boiler operating at 700 lbs. pressure. Solubilities were made in a large number of steel bombs, under conditions of equilibrium, which took generally 6 to 10 hrs. to reach. Assuming possibility that equilibrium does not exist in all parts of a boiler and also perhaps factors other than solubility affect scale formation, final tests are being conducted in an actual operating boiler designed for pressures up to the critical. Thus far from the bomb solubility data it is indicated that soda-ash treatment, properly controlled, should prevent $CaSO_4$ scale at pressures up to 1500-2000 lbs. without causing high alkalinities and without disturbing recommended embrittlement ratios. Additional factors are discussed. DTR (4)

Effective Elimination of Corrosion in Hot Galvanizing Plant Pots. (Wirksame Vermeidung von Anfressungen der Kessel bei Feuerverzinkungsanlagen.) E. Schrieder. *Stahl und Eisen*, Vol. 52, May 12, 1932, pages 470-471.

According to H. Grubitsch's work published in *Stahl und Eisen*, Vol. 51, 1931, pages 1113-1116, Fe is practically not attacked by molten Zn up to 475° C. From 475° to 490° C. the solubility rises rapidly, and with further temperature rise, the solubility decreases, reaching a minimum at 520° C. and above this it starts increasing gradually. Explanation for pitting and corrosion lies in local excessive heating above 475° C. and the pits appear as circular funnel shapes of about 3 to 5 cm. diameter. For protection against this pitting a novel yet simple method was devised by which an air space was allowed for between fire brick or fireclay and pot wall. This air space permits holding the temperature below 475° C. and gives uniform heat radiation without local heating. DTR (4)

Cadmium and Zinc Plating as Corrosion Preventives. S. Wernick. *Metallurgist*, Sept. 1931, pages 143-144; Oct. 1931, pages 147-148.

An article based on a paper before the Electroplaters' and Depositors' Technical Society. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 216. VVK (4)

Rust-Proofing Processes. *Automobile Engineer*, Vol. 21, Nov. 1931, page 544.

2 anti-rust processes developed by the Pyrene Company, Ltd., Great West Road, Brentford, are known as Parkerizing and Bonderizing. The Parkerizing process converts the surface of the treated metal to an insoluble phosphate which, under ordinary atmospheric conditions, is impervious to rust. Bonderizing gives a non-metallic coating which acts as a key to the finish. Briefly describes each process. RHP (4)

Rust Protection by the Atrament Method. (Rostschutz durch das Atrament Verfahren.) *Stahlbautechnik*, Supplement to *Montanistische Rundschau*, Vol. 24, Mar. 16, 1932, pages 7-8.

The Atrament method is a new coating method against corrosion, developed by the German Dye Trust. By dipping iron parts in a solution of phosphorous salts of a certain concentration a dense layer of phosphate is deposited which is insoluble in water. In a 2½% solution of "Atramenthol" the process takes about ½ to 1 hr. at 98° to 100° C. GN (4)

Corrosion of Metal Articles in Storage. Influence of Alkaline Surface Films. W. E. Cooper. *Industrial & Engineering Chemistry*, Vol. 23, Sept. 1931, pages 999-1002.

It is shown how the presence of small amounts of alkali deposited as an apparent uniform layer on metal articles serves to increase their freedom from tarnishing and rusting when stored in warehouses. Also, by choosing the most protective alkaline deposit, and adjusting and maintaining storage conditions in a state of constant control, it is possible to store articles for very many years without loss of luster. It is suggested that many cases occur where articles are being dipped in grease for storing, whereas investigation might prove that suitable alkaline treatment and control of warehouse conditions would result in considerable saving of storage costs by utilizing a cheaper method. MEH (4)

Distribution Sub-Committee on Pipe Coatings and Corrosion. J. K. Crowell. *American Gas Journal*, Vol. 136, May 1932, page 48.

Report of sub-committee to Distribution Conference. The findings of the committee include: (1) The only practical means of reaching a satisfactory solution of the problem of the protection of underground piping from corrosion is painstaking and necessarily slow research by those who are in a position to give their entire time to the work. (2) The protective value of a coating depends primarily upon the nature of the coating and to a minor extent upon the soil. (3) When a coating fails, the pitting rate depends upon the soil. (4) Electrical conductance and pinhole tests are useful methods for determining the protective value of coatings. (5) Protective value of a coating is increased by increasing the thickness, within certain limits. (6) Mechanical distortion after application is the principal cause of bituminous coating failures. (7) Organic reinforcing materials are decomposed by bacteria and fungi in the soil and the extent of this action depends upon the nature of the soil and the amount of protection by the use of disinfectants or bitumens. (8) Thin coatings do not add enough to the life of the pipe to justify their use. (9) The corrosiveness of a soil cannot as yet be accurately determined by the use of any method. (10) Corrosiveness of a soil can be fairly accurately determined by the use of a combination of methods. CBJ (4)

Progress in Fighting Corrosion. (Fortschritte in der Korrosionsbekämpfung.) H. Hebberling. *Die Werkzeugmaschine*, Vol. 36, Mar. 15, 1932, page 89.

The article refers in particular to the progress made in protective coatings made of oil lacquers, paints, etc. GN (4)

Economy in Wider Use of Protective Coatings on Pipes. Wm. Thompson Smith. *Engineering News-Record*, Vol. 108, Apr. 21, 1932, pages 576-578.

The problem of deciding whether to give an underground pipe line a protective coating or not is complicated by the varying conditions encountered. The cost of coating an entire line is a considerable item, on the other hand if no coating is given the line, localized areas may corrode through in a short time and cause severe losses. Sections of ground where soil corrosion is markedly severe are termed "hot spots." The best warranted method of saving in protection costs is not by waiting for hot spots to develop before using any coating but by coating all known or suspected areas of corrosion and omitting coating in non-corrosive areas as determined by a thorough soil-corrosion survey. CBJ (4)

Standardization of Tests for Corrosion of Light Metals. (Normalisation des Essais de Corrosion des Alliages Legères.) *Revue de l'Aluminium*, Vol. 9, Jan.-Feb. 1932, pages 1650-1660.

The different methods employed by European Al-producing companies for testing their products are described. Ha (4)

Corrosion Tests of Ferrous Metals. *Metallurgist*, Mar. 1931, pages 42-43.

A review of a paper by Pitschner. See "A Proposed Method for Accurately Evaluating Results of Corrosion Tests of Ferrous Metals," *Metals & Alloys*, Vol. 1, Dec. 1930, page 902. VVK (4)

STRUCTURE OF METALS & ALLOYS (5)

The Influence of Third Metals upon the Constitution of the Brasses. IV. The Influence of Aluminum. (Der Einfluss von dritten Metallen auf die Konstitution der Messinglegierungen. IV. Der Einfluss von Aluminium.) O. Bauer & M. Hansen. *Zeitschrift für Metallkunde,* Vol. 24, Jan. 1932, pages 1-6.

The ternary system Cu-Zn-Al was investigated in the composition range 100 — 50% Cu and 0 — 10% Al, by thermal and micrographic studies of alloys with constant Al content at 1, 2, 4, 6, 8, and 10% respectively. The solidification of these ternary alloys is quite analogous to that of the respective binary alloys. Within a certain range of composition the peritectic reactions α + melt $\rightarrow$ β and β + melt $\rightarrow$ γ take place. The peritectic temperatures in the Cu-Zn system are lowered by the addition of Al. Three one-phase fields obtain in the ternary system: α, β, and γ; 3 two-phase fields: $(\alpha + \beta)$, $(\beta + \gamma)$, and $(\alpha + \gamma)$; and one three-phase field: $(\alpha + \beta + \gamma)$. The limit of the saturated phase in the Cu-Zn system is displaced to 72.5% Cu by the addition of 3.5% Al; the limit of the saturated field in the Cu-Zn system is displaced to 65.5% Cu by the addition of 4.25% Al. Al-contents greater than 3.5 — 4.25% induce the formation of the brittle γ-crystals. The influence of Al upon the color and Brinell hardness is noted. It is concluded that the usefulness of brasses modified by the addition of Al has been under-estimated. The paper includes a critical study of previous work in the system. RFM (5)

Metallography & Macrography (5a)

Solidification Temperatures of Cast Bronze and Red Brass. (Estarrungstemperaturen der Gussbronzen und Rotgusslegierungen.) O. Bauer & M. Hansen. *Zeitschrift für Metallkunde,* Vol. 24, Mar. 1932, page 63.

The following data are given: alloy with Cu 90%, Sn 10%: beginning of freezing 1009° C.; alloy with Cu 86%, Sn 14%: beginning of freezing 971° C., peritectic reaction (α + melt $\rightarrow$ β) and end of freezing 793° C.; alloy with Cu 80%, Sn 20%: beginning of freezing 898° C., peritectic reaction (α + melt $\rightarrow$ β) and end of freezing 797° C.; alloy with Cu 79%, Sn 8%, Pb 13%: beginning of freezing 959° G., first separation of Pb 891° C., reaction α + liq.Cu $\rightarrow$ β + liq.Pb 764° C., end of freezing (crystallization of Pb-rich phase) 314° C.; alloy with Cu 86%, Sn 10%, Zn 4%: beginning of freezing 1000° C., reaction liq.Cu $\rightarrow$ β + liq.Pb 788° C., reaction α + liq.Cu $\rightarrow$ β + liq.Pb; alloy with Cu 85%, Sn 9%, Zn 6%: beginning of freezing 994° C., peritectic reaction (α + melt $\rightarrow$ β) 787° C.; alloy with Cu 85%, Sn 5%, Zn + Pb 10%: beginning of freezing 1016° C., reaction liq.Cu $\rightarrow$ α + liq.Pb 887° C. RFM (5a)

Large Grain Size in Aluminium Wire. Clement Blazey. *Chemical Engineering & Mining Review,* Vol. 24, Mar. 5, 1932, pages 193-196.

Al rivets are influenced by grain size. Brinell impressions of good rivets are circular in outline while those of bad rivets are irregular in shape. A single crystal of metal does not take a spherical impression. When the crystal grain is larger than the ball impression, the directional properties of the grain will influence to a noticeable degree the shape of the impression. It was impossible to produce even-headed rivets from coarse-grained metal. To produce coarse-grained metal, a critical amount of cold work, followed by a critical annealing temperature, is necessary. WHB (5a)

The Miscibility Gaps in the Systems Lead-Copper and Lead-Copper-Tin. (Die Mischungslücke in den Systemen Blei-Kupfer und Blei-Kupfer-Zinn.) S. Briesemeister. *Zeitschrift für Metallkunde,* Vol. 23, Aug. 1931, pages 225-230.

The methods for the determination of the solubility curve between the 2 liquid layers in metals showing a miscibility gap in the liquid state are reviewed, and that consisting in removing samples from the 2 layers with subsequent chemical analysis indicated as the most trustworthy. Using this method the critical point (maximum temperature and accompanying composition) in the Pb-Cu system was found to be at 1000° C. and 65% Pb; the composition range of immiscibility at the monotectic temperature was found to extend from 60 or 61% to 7.5% Cu. The first effect of adding Sn to the Pb-Cu system is to widen the miscibility gap. Solubility isotherms are given for the temperatures 835°, 955°, 1005°, 1060° and 1110° C. The effect of Sn in widening the miscibility gap is explained by the presence of Cu_3Sn molecular complexes in the molten alloy. These complexes on increasing temperature dissociate and the solubility accordingly increases. The critical point is determined to be at 1130-1140° C. and at the composition 35% Cu, 50% Pb, 15% Sn. The importance of these results in the manufacture of Pb-bearing bronzes is discussed. RFM (5a)

Regeneration of the Recrystallization Ability by Retro-Formation. (Rückbildung der Rekristallisationsfähigkeit durch Rückformung.) P. Beck & M. Polanyi. *Die Naturwissenschaften,* Vol. 19, June 5, 1931, pages 505-506.

See *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 91. EF (5a)

Studies upon the Systems Ag-Sb-Zn, Ag-Cd-Sb and Ag-Cu-Sb. (Zur Klärung der Systeme Ag-Sb-Zn, Ag-Cd-Sb und Ag-Cu-Sb.) W. Guertler & W. Rosenthal. *Zeitschrift für Metallkunde,* Vol. 24, Jan. 1932, pages 7-10; Feb. 1932, pages 30-34.

The constitution of the systems Ag-Sb-Zn, Ag-Cd-Sb, and Ag-Cu-Sb was studied metallographically and by the use of Guertler's "Klarkreuz" method, chiefly because of the interest in these alloys in the development of new Ag alloys. The results are expressed in a series of constitutional diagrams. Difficulties in the application of the "Klarkreuz" method, the etching characteristics of the alloys studied and the technical use of the alloys are discussed. RFM (5a)

The Iron-Beryllium System. R. H. Harrington. *Metals & Alloys,* Vol. 3, Feb. 1932, pages 43-45.

The author shows 11 micrographs obtained from the case on the surface of cold rolled steel subjected to a "beryllizing" treatment in powdered beryllium at 1000° C. to check qualitatively certain discrepancies in the published work on the Fe-Be diagram. The results appear to agree with the diagram of Oesterheld with the exception of the extention of the eutectoid line to very low beryllium. The diagram is reproduced. WLC (5a)

The Austenite-Pearlite Inversion. H. C. H. Carpenter & J. M. Robertson. (Royal School of Mines). *Iron & Steel Institute, Advance Copy* No. 7, May 1932, 20 pages.

The pearlite transformation was studied by examining microstructures of several C steels that had been subjected to special heat treatments. Steels containing 0.43, 0.73 and 0.81% C were cooled in such a manner to produce an appreciable temperature gradient in the samples and quenching when pearlite had formed in part of the sample. Several cooling rates were used. Specimens were also non-uniformly heated to the transition range and cooled rapidly. It is pointed out that in ordinary steels the pearlitic transformation occurs over a range of temperatures because of the impurities in the steel. Even with slow cooling of pure Fe-C alloys the transformation occurs over a range, but if the steel is held at or below a certain temperature the change proceeds to completion. Possible mechanics for the formation of ferritic and cementitic lamallae are discussed. The microstructures showed that the ferrite and cementite form simultaneously, and a given particle of pearlite consists of plates advancing edgewise into the austenite. The dependence of the form of the pearlite on the C content and rate of cooling is discussed. 10 references. JLG (5a)

Black Magnetic Rouge Polishes Rapidly and Without Flow. W. J. Crook & W. R. Philbrook. *Metal Progress,* Vol. 21, May 1932, pages 72-74.

Black rouge, 99% Fe_3O_4, has been found to be superior to either magnesia or alumina as a final polishing material for preparing specimens for microphotography. WLC (5a)

Thermodynamic Investigations of the System Iron-Carbon-Oxygen. II. (Thermodynamische Untersuchungen zum System Eisen-Kohlenstoff-Sauerstoff. II.) H. Duenwald & C. Wagner. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 205, Apr. 8, 1932, pages 205-208.

Discrepancies in the measurements and calculations of the equilibrium diagram in a previous investigation of Krings are discussed. Diffusion constants are in reality no constants of the material but depend on the structure of it and change with structural changes. Ha (5a)

On the Supposed Allotropy of Lead. W. Eda. *Kinzoku no Kenkyu,* Mar. 1932, pages 125-130 (In Japanese); *Science Reports Tohoku Imperial University,* Vol. 20, 1931, pages 715-725 (In English).

The existence of an allotropy of Pb at 200° C. was suggested by F. Hargreaves. But as he only made a hardness test on quenched Pb, the author repeated the investigation by means of hardness tests (both at room temperature and at high temperature), electric resistance measurements, differential thermal analyses and X-ray investigations. In the case of single crystals of Pb no abrupt change of hardness was found. Also no abrupt change was observed in electric resistance or on differential thermal analysis. Moreover, no evidence of allotropy was detected by X-ray analysis. Hence the author concluded that lead has no allotropy in the temperature range of 20°-300° C. KT (5a)

The Reactivity of Metal Alloys and Their Dependence on Fusion Phenomena or Transformations in Solid State. (Die Reaktionsfähigkeit der Metallegierungen und ihre Abhängigkeit von Schmelzerscheinungen oder Umwandlungen im festen Zustand.) J. Arvid Hedvall & F. Ilander. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 203, Jan. 26, 1932, pages 373-389.

The reactions between metals when adding basic oxides in the presence of oxygen take the same course as found formerly for additions of sulphides, phosphides, carbides and silicides, and there is no difference whether the metals are solid or in fusion. It could be stated that Cu-Sn alloys in various compositions in the presence of oxygen can attack crucible material containing Ca or Si even at temperatures as low as 400° C. Ha (5a)

The Behaviour of Single Crystals of Bismuth Subjected to Alternating Torsional Stresses. H. J. Gough & H. L. Cox. *Institute of Metals, Advance Copy* No. 592, Mar. 1932, 21 pages.

2 single crystals of Bi were subjected to alternating torsional stresses and the mechanism of deformation studied. In the early stages of the tests numerous bands were formed parallel to the twinning planes. No slip bands were observed at any stage. Values of normal and shear stress for various planes in the crystals were calculated. The mechanism of deformation is discussed at length. 10 references. JLG (5a)

The Recrystallization of Aluminum and Some Refinable Aluminum Alloys. (Ueber die Rekristallisation von Aluminium und einigen vergütbaren Aluminiumlegierungen.) H. Haneman & R. Vogel. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 4, Jan.-Feb. 1932, pages 3-23.

The investigations made on the recrystallization and the development of the recrystallization diagram, that is the diagram showing the grain size of the recrystallized metal for the selected recrystallization time as function of the degree of deformation and of the temperature at which recrystallization takes place, are reviewed and diagrams of more recent tests are discussed. In general, the recrystallization temperature of pure Al is increased by the alloying components. Small amounts of Mn and Si reduce the recrystallization ability. The velocity of deformation exerts a great influence on the formation of the recrystallization structure. The hypothesis of Tammann was corroborated, that is, that just for Al the effect of the intermediary substance is of greatest importance for the recrystallization. These recrystallization diagrams are, however, valid only for material that has been thoroughly worked and has a very fine grain; that means where the intermediary substance is in the most finely distributed form in the material. For the practical forging of refinable Al alloys the following directions are given for the prevention of coarse grain: The range of critical elongation lies between 5 and 20%; forging should therefore be done at rather high temperature. To avoid critical deformation, it should be effected with few but strong blows; the same degree of deformation obtained by many light blows results in coarser grain. When deforming under the press, small velocities of deformation must be avoided as they cause a coarse grain. Ha (5a)

Testing the Material in Hollow Cylinders with a Cinematograph. (Materialprüfung von Hohlzylindern auf kinematographischen Wege.) *Maschinenkonstrukteur - Betriebstechnik,* Vol. 65, Feb. 10, 1932, pages 14-17.

A new method for testing inaccessible parts of the walls in long hollow tubes is described. The X-ray is used. MAB (5b)

Hunt Defects with Large X-Ray. *Foundry,* Vol. 59, Dec. 15, 1931, pages 29-30.

Description of a new X-ray laboratory of the General Electric Company, Schnectady. It is equipped with a substation, rooms for taking X-ray pictures, photographic dark room and air conditioning plant. A 200,000 volt X-ray tube is used. VSP (5b)

X-Ray Crystal Analysis in Industrial Problems. *Engineering,* Vol. 133, Jan. 8, 1932, pages 29-30.

Brief summary of a report of a committee of the Department of Scientific and Industrial Research entitled "The Application of X-ray Crystal Analysis to Industrial Problems." Examples are given of the type of work being done and the results obtained. X-ray photographs are reproduced. LFM (5b)

Atomic Arrangement and Properties. Research on the Alloy $AuCu_3$. (Atomordnung und Eigenschaften. Untersuchungen an der Legierungen $AuCu_3$.) G. Sachs & J. Weerts. *Mitteilungen der deutschen Materialprüfungsanstalten,* 1932, No. 12, pages 182-183. (Abstract.)

See *Metals & Alloys,* Vol. 3, May 1932, page MA 126. HWG (5b)

Internal Stresses and Their Roentgenographic Proof. (Innere Spannungen und ihr Roentgenographischer Nachweis.) Fritz Regler. *Mitteilungen der technischen Versuchsamtes in Wien,* Vol. 20, Nos. 1-4, 1931, pages 43-58.

Structure diagrams taken by the Laué method do not always give a real picture of the inner condition of the crystals as the very thin sample prepared for the Laué test mostly affords an opportunity for the equalization of inner stresses as the sharp photographs show. Stresses would give a certain lack of clearness. The author developed a method which permits taking reflection diagrams of its fine structure with X-rays directly on the work piece; this method has the further advantage that it does not injure the material and the crystal lattice has no opportunity to change its state because it is not machined. The diagram is taken by reflecting a parallel beam of X-rays on the piece to be examined. The difference between the diagrams of materials with inner stresses due to the treatment of the material and stresses due to outer influences as tension, pressure, etc., are explained and illustrated. The methods of taking the diagrams and evaluating them is described in detail. The method has been developed so that now also quantitative measurements of stresses especially in the elastic range can be made in the shop. Ha (5b)

Atomic Physics and Metallurgy. (Atomphysik und Metallkunde.) E. Piwowarsky. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 7 pages.

See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 36. (5b)

Quantitative X-Ray Analysis. Henry Terrey & E. G. V. Barrett. *Journal of Physical Chemistry,* Vol. 35, Apr. 1931, page 1156.

In general the alloy to be analyzed is made the anticathode in an X-ray tube and the relative intensities of the characteristic radiation of the different atomic species present are determined. It is thought that the anomalies in previous results were due to absorption of the characteristic radiation of one element by another element present in the anticathode. It is shown that for elements near each other in the periodic system the relative intensities of two similar characteristic lines is proportional to the atomic concentration of each. The relative intensities of the $K\alpha_{2\cdot1}$ lines were measured for a series of Cu-Zn, and a series of Cu-Ag alloys. These two series of alloys were selected since Cu absorbs the $K\alpha_1$ line of Ag but not that of Zn. To avoid errors in estimating blackening of the photographic film an ionization method was used for intensity determination; also a photographic method involving an Al absorption wedge was used in which lengths instead of blackness could be measured. In the Cu-Ag alloys the following relation between intensities and concentration was found to hold:

$$\frac{I_{Ag}}{I_{Cu}} = M \frac{C}{C_{Ag} + C_{Cu}}$$

where M is a proportionality constant. The Ag radiation suffers partial absorption in the Cu and gives rise thereby to secondary Cu radiation, thus diminishing the Ag radiation and augmenting the Cu. A linear relationship between relative intensity and atomic concentration was found to hold for the Cu-Zn alloys. WHK (5b)

Dispersion of Aluminum in the Range of 1.1 - 2.3 A.U. (Dispersion von Aluminium im Gebiet von 1.1 - 2.3 A.E.) H. Steps. *Die Naturwissenschaften,* Vol. 19, July 10, 1931, page 617.

By a photometric method the dispersion of Al was investigated and found to be in accordance with the Drude-Lorentz equation. EF (5b)

X-Ray Analysis of the Gold-Tin Alloys. (Roentgenanalyse der Gold-Zinn-Legierungen.) Sten Stenbeck & A. Westgen. *Zeitschrift für physikalische Chemie,* Vol. 14, Sec. B, Sept. 1931, pages 91-96.

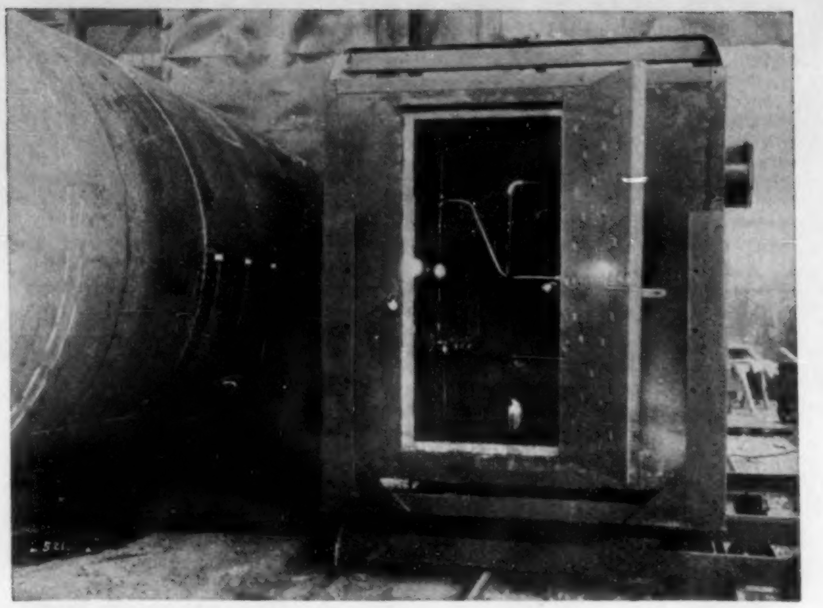
Besides the known compounds AuSn, $AuSn_2$ and $AuSn_4$, another fourth intermediary phase exists in the range from 12 to 16 atomic % Sn. The lattice structures of the compounds were examined by X-rays; they seem to be very complicated as they show very many lines. Ha (5b)

X-Ray Scattering and Atomic Structure. E. O. Wollan. *Reviews of Modern Physics,* Vol. 4, Apr. 1932, pages 205-258.

The theory of the reflection of X-rays from crystals is reviewed, as well as scattering of X-rays by gases and diffuse scattering of X-rays by crystals. A comparison of various methods of obtaining the atomic structure factor is also included. A bibliography of 96 references is appended. WAT (5b)

Radiographic Picture of a Welded Seam. (Röntgenuntersuchung eines Schweissmusters.) *Zeitschrift für Schweisstechnik,* Vol. 21, Aug. 1931, page 187.

Disregarding a few minor discontinuities due to slag inclusions or blowholes, a very perfect and uniform gas-welded seam was secured as disclosed by the X-ray photograph. EF (5b)



Testing Methods for Welded Tube Joints. (Prüfungsverfahren geschweisster Rohrverbindungen.) *Die Röhrenindustrie,* Vol. 24, May 24, 1931, pages 123-124.

Visual examination, X-ray inspection by radiographic photography and examination on a fluorescence screen, electromagnetic tests (tests in the Technische Hochschule Braunschweig and in the Kaiser Wilhelm Institut für Eisenforschung), etching methods (Dampfkesselüberwachungsverein) Brinell hardness tests, bending, tensile, microscopic and various kinds of pressure tests are reviewed. EF (6)

Attainment of a Constant Bend in Deflection Test Work. (Erreichung einer stetigen Krümmung bei der technologischen Biegeprobe.) *Stahl und Eisen,* Vol. 52, Apr. 28, 1932, pages 409-411.

Illustrations of old and new methods of making bends of test samples. The new die or stamp shape produces a uniform, even and constant bend in deflection samples. Curves are given for % elongation by old and new ways for angles up to 170°. DTR (6)

The Testing of Iron Castings. A. W. Walker. *Foundry Trade Journal,* Vol. 46, Apr. 14, 1932, pages 233-235.

Deals with the factors influencing the strength of cast Fe and then passes on to discuss the value of the transverse, tensile and Brinell hardness tests in determining mechanical characteristics of this material. Some reference is made to modern methods of producing special cast irons. OWE (6)

Examination of Deep Drawing Quality of Sheet Metal. (Untersuchungen über die Prüfung der Tiefziehfähigkeit von Feinblechen). Fritz Eisenkolb. *Stahl und Eisen,* Vol. 52, Apr. 14, 1932, pages 357-364.

Report 178 of Committee on Materials of Verein deutscher Eisenhüttenleute. Includes discussion. According to the author a sheet should be judged by 2 properties: (1) by number of draws necessary to obtain desired shape; (2) maximum amount of drawing without having to anneal. Effect of irregularities in chemical composition was shown by Erichsen tests on 1000 × 2000 × 1 mm sheets. For composition 0.058% C, 0.32% Mn, 0.018% P, 0.017% S, and original Erichsen 11.3, after 4th draw final Erichsen was 6.9; similarly for composition 0.072% C, 0.32% Mn, 0.028% P, 0.026% S, original Erichsen 11.2, after 4th draw final Erichsen 6.2. Purer material gives better deep drawing quality. Effect of annealing, that is, effect of crystal structure is shown by following:

Structure	Erichsen Original	Erichsen After 4th draw
1. Banded cementite	11.3	6.7
2. Heavily banded pearlite	11.4	8.1
3. Banded pearlite	12.1	8.2
4. Granular cementite	11.8	8.2

Slight advantage in deep drawing quality is observed when the spinning or stamping is perpendicular to the direction of rolling. With an original Erichsen 10.8, on 18 test sheets, on material drawn parallel to direction of rolling, the average final Erichsen was 6.8; perpendicular to rolling direction, 7.8. With the latter material T.S. and elastic limit were higher, % elongation and Amsler deflection No. were less. When several spins or stamps are to be made, test data showed much better results by making successive draws as soon as possible, while material is still warm. This confirms the practical method of spinners and stampers. Average values of all physical properties for 10 classes of sheets, rolled, drawn and annealed in various ways are tabulated in order to show that various test methods do not always agree and that a more general method should be developed. In order that sheets may have good uniform deep drawing quality they should be of uniform gage, smooth throughout entire surface, without scratches, oxide inclusions, or other defects and uniform in crystal structure. DTR (6)

Sockets of Low-Melting Alloy Best for Wire-Rope Test Samples. D. H. Corey & E. T. Cope. *Engineering News-Record,* Vol. 108, May 5, 1932, page 652.

Samples of wire rope socketed with spelter broke near the sockets and gave low tensile strengths. From the location of the breaks it was thought that the skin hardness, resulting from cold drawing of the wire in manufacture, had been decreased at the temperature at which the spelter was poured, about 1000° F. Alloys of low melting point were investigated. When samples were socketed with 83-7-10 Pb-Sn-Sb alloy of a pouring temperature of 500-650° F., better tensile strengths were obtained. The location of the failures were such that it appeared that the full strength of the rope was being developed. CBJ (6)

Magnetostriction of Ferromagnetic Materials (Magnetostriktion ferromagnetischer Stoffe). G. Dietsch. *Zeitschrift für technische Physik,* Vol. 12, July 1931, pages 380-389.

A testing method is described which, in comparison with the testing equipment formerly used, yielded an increase in sensitivity of the "balance method" amounting to 2 decimals. This is achieved by the utilization of shorter wave lengths (70 m.), smaller distances of the condenser plates (0.02-0.003 cm.) and by the application of relatively long samples (28.5 cm.). In the case of electrolytic Ni, remarkable hysteresis phenomena were observed, which sometimes yielded positive values never measured before. An influence is exerted by the pre-treatment. A second set of tests refer to Be-Ni alloys. In those samples submitted to an age-hardening treatment, a decrease in magnetostriction was observed, due to the disintegration of the solid solution. While no material changes were noticed with Be-permalloy alloys (0.5 and 1% Be), the stainless steel used (0.17% C, 1.8% Ni, 14.2% Cr) exhibited considerably larger changes of the length in the magnetic field in comparison with electrolytic iron. The influence of preceding mechanical stress exceeding the limit of elasticity generally results in a decrease in magnetostriction. An initial increase, however, was observed in electrolytic Fe and in age-hardening Be-Ni starting at a field density of about 100 Gauss. Slight elongations of 1-2% cause more pronounced changes in magnetostriction than large degrees of elongation. A dynamic pre-treatment did not exert any influence upon the course of the striction-curves. EF (6)

Effect of Size of Test Bars on Transverse Test Results of Cast Iron. (Einfluss der Probestabmasse auf die Ergebnisse des Biegeversuchs bei Gusseisen.) Gustav Meyersberg. *Archiv für Eisenhüttenwesen,* Vol. 5, Apr. 1932, pages 513-517.

A study was made of the effect of diameter and of ratio of test bar length to diameter on transverse test results of unmachined cast Fe rods. Deflection (f) and strain number (Z_f) decrease with decreasing d and ls/d ratio; modulus of rupture (σ_B) increases. Z_f and f may be computed from Hooke's law; the effect of structural changes of the material through varying cooling conditions is deciding factor in the case of σ_B. Any additional variations from Hooke's law may be seen from curves plotted from test data. Equations were derived giving relations between ls/d = λ and d, for f, Z_f and σ_B. Equation $f = \frac{\sigma_B}{6E} : \lambda^2 d$ was also derived where E = modulus of elasticity. Average deviations of individual values from group average values for variations in diameter are given. DTR (6)

Methods of Testing Gray Iron Bars and Castings. (I Metodi di prova della ghisa gregia e il collauda dei getti). I. Musatti & G. Calbiani. *La Metallurgia Italiana,* Vol. 24, Apr. 1932, pages 267-291.

A very complete survey of the testing methods and test bars in use for gray iron throughout the world, with suggestions for the development of Italian standards, after a coöperative study which is outlined. It is emphasized that the bars adopted should, as far as is feasible, correspond to the standards of other countries so that published data will be directly comparable. Comparisons are suggested on (a) transverse bars 30 mm. diam. tested on 300, 455 and 600 mm. centers and on those of 40 and 55 mm. diam., on 455 mm. centers. (b) tensile bars, (c) Frémont shear tests, (d) compression on 16 × 16 mm. and 20 × 20 mm. specimens, (d) Brinell and (e) a small Frémont transverse test. It is suggested that test bars should be cast of such cross section as to approximate that of the castings into which the iron is to be poured, and that the Brinell relationship of these bars and of the castings themselves be used to show how nearly the bar represents the casting. The tensile test is not considered very suitable for routine testing because of difficulties in accurate testing of non-ductile material. The Frémont test is considered more practical. 79 references. HWG (6)

The Resistance to Wear of Carbon Steels. Samuel Rosenberg. *Transactions American Society for Steel Treating,* Vol. 19, Jan. 1932, pages 247-270.

Includes discussion. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 37. WLC (6)

Mechanical Properties of Gray Iron Castings. (Caractérisation des propriétés mécaniques des pièces moulées en fonte grise). Albert Portevin. *Revue de Métallurgie,* Vol. 29, Feb. 1932, pages 61-73.

A critical survey of the methods used for testing cast iron castings. 61 references. JDG (6)

Methods of Testing Cast Iron. The Zürich Discussion. J. G. Pearce. *Bulletin British Cast Iron Research Association,* Vol. 3, Apr. 1932, pages 88-90.

The conclusions drawn from the discussions summed up by the president are briefly that in the opinion of the great majority the use of a separately cast test-bar, to be tested in tension and bending, is regarded as satisfactory and sufficient for the majority of industrial purposes; but for the exploration of the properties of various parts of castings and for the study of variations from one casting to another and for the investigation of failures of castings in service, the small test piece cut from the casting itself should be used. Ha (6)

The Shape of the Tensile Test Bar for Cast Iron. J. G. Pearce. *Bulletin British Cast Iron Research Association,* Vol. 3, Apr. 1932, pages 86-88.

The standard tensile test bars in Great Britain, America and Germany are described and compared and a series of systematic tests with a material of a definite composition were made to find the influence of the shape of the samples on the strength. The conclusions from the tests are that there is no regular variation in strength with grip length nor with gage length. Irrespective of these 2 lengths, the tensile strength was constant to within ± 5%, the variations being very likely due to the material itself. Ha (6)

Magnetostriction of Metals. J. S. Rankin. *Iron & Coal Trades Review,* Vol. 124, Mar. 18, 1932, page 472.

Tests are described for finding the effect of successive draws of wires on magnetostriction. The formerly assumed explanation of the decrease in magnetostriction with drawing seems not to be corroborated; at least, it can not be attributed to inner stresses. An exact explanation can not yet be given. Ha (6)

The Testing of Castings. Walter Rosenhain. *Institute of Metals, Advance Copy* No. 601, Mar. 1932, 13 pages.

Opening address for a general discussion held at the annual meeting of the Institute of Metals, Mar. 10, 1932. A general discussion of sampling and testing methods with particular reference to the testing of cast iron. Reasons are given for favoring a separately cast test bar. Includes an appendix summarizing the conclusions reached at the Zürich meeting of the New International Association for Testing Materials regarding the testing of cast iron. The majority of those at the meeting favored a separately cast test bar. JLG (6)

The Wear of Cast-Iron Brake Blocks (Beiträge zur Abnutzung gusseiserner Bremsklötze). E. Scharffenberg. *Die Giesserei,* Vol. 19, Apr. 15, 1932, pages 145-149.

On the basis of wear tests curves are derived which show the wear of material in mg./kg./hr. as a function of the content of Si (from 0.9 to 2.3%), of Mn (from 0.4 to 2.2%), of P (from 0.3 to 0.9%), and of S (from 0.04 to 0.21%). The tests showed also that the temperature occurring during the wearing does not give an indication of the resistance to wear, but Brinell hardness and wear showed a certain relation. P and S retard wear while Si increases wear at contents of more than 1.7% Mn shows an optimum at 1.4%. Ha (6)

ELECTRO-CHEMISTRY (7)

Investigations of the Temperature Dependency of Copper and Silver Single Potentials. (Untersuchungen über die Temperaturabhängigkeit von Kupfer und Silbersalzen Einzelpotentialen.) R. BURIAN. *Zeitschrift für Elektrochemie,* Vol. 37, May 1931, pages 238-251.

To determine the temperature coefficient of solutions the activity of which depends upon their temperature (entropy changes of the ionization process), careful measurements on Cu electrodes against $CuSO_4$ solutions were undertaken. Measurements with *M* $CuS0_4$ without additions of acid showed a fall of potential, π, above 40° C., and a precipitate appeared on the electrode; when 0.01 *N* H_2SO_4 was added, the temperature coefficient up to 60° C. was positive and nearly constant; above 60° the increase in potential was larger; no precipitate appeared on the electrode; on cooling, metallic Cu precipitated from solution. The average value of $d\pi/dT$ for Cu *M* $CuSO_4$, 0.01 *N* $H_2SO_4 = 7.9 \times 10^{-4}$ v. between 20° and 60° C.; for 0.1 *M* $CuSO_4$ and 0.001 *N* H_2SO_4 between 25° and 60° C. the coefficient is 7.2×10^{-4} v.; for 0.01 *M* $CuSO_4$ in the latter case a value of 4.3×10^{-4} was obtained. Cooling after heating the electrode produces a lower e.m.f. than the original corresponding to the same temperature on account of precipitation of basic salts on the electrode. In general the experimental results agree well with calculated. For Ag | n *M* $AgNO_3$ the following results were obtained: 3.162 *M* $AgNO_3$ between 18° and 45° C. gives a coefficient of -0.000148 V. per degree; 0.3162 *M* $AgNO_3$ between 18° and 55° C., 0.00030 V. per degree; 0.1 *M* $AgNO_3$, 12°-65° C., -0.00042 V. per degree; 0.01 *M* $AgNO_3$, 17-60° C., -0.00065 v. per degree. The temperature coefficient for the normal calomel electrode was redetermined in this work; between 20° and 48° C. it averages 0.00057. Ha (7)

Temperature Measurements on Electrodes in Motion. V, VI. (Temperaturmessung an arbeitenden Elektroden. V, VI.) B. BRUZS. *Zeitschrift für physikalische Chemie,* Sect. A, Vol. 155, Aug. 1931, pages 392-402; Oct. 1931, pages 279-290.

A dynamic calorimeter yielding a sensitivity in temperature indication of 1.8×10^{-6} degree/mm. and a thermal (Peltier) sensitivity of 4.5×10^{-7} watt/cm.² is described. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 257. EF (7)

The Buffer Action of Tungstate Solutions. (Ueber die Pufferwirkung von Wolframatlösungen.) WALTER QUIST & ALMAR LUND. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 205, Apr. 8, 1932, pages 87-94.

By adding a dilute acid to certain tungstate solutions aggregation reactions take place in which new, tungsten-rich anions are formed. The relation of the pH value to the concentration of sodium tungstate solutions is determined and results tabulated. Ha (7)

Electroplating (7a)

Rapid Nickel Plating. C. H. ELDRIDGE. *Monthly Review, American Electroplaters Society,* Vol. 19, Mar. 1932, pages 21-29.

Paper before Detroit Branch Meeting, Feb. 1932. The author gives a comparison of present-day practice in rapid Ni plating in the U.S.A. and in Europe. French platers use the following formula.

$NiSO_4 7H_2O$	53-67 oz./gal.
$NiCl_2 6H_2O$	3 oz./gal.
H_3BO_3	3 oz./gal.
$Ni(NO_3)_2$, 20% solution	3-4 cc./gal.
pH	4.8-5.7
Temperature	45-55° C.
Current density	75-110 amp./ft.²

Before nickel plating, steel parts are anodically treated in 53° Be. H_2SO_4 for 10-30 sec. at 150 amp./ft.². The Ni deposit is usually 0.0008 to 0.001" thick. Cu under-coating is not used. English practice uses a formula similar to the French practice. Current density used is lower. Bath is agitated by compressed air and filtered continuously. Anodes are bagged. Anodic cleaning of steel parts uses a strong H_2SO_4 containing 3 oz./gal. $K_2Cr_2O_7$. In American practice, there are 2 types of baths, the high and the low pH baths. The high pH bath is not unlike those used in France and England. Solution is continuously filtered. Current density used is such as to give 0.001" in 10 min. The low pH bath has lower Ni content:

$NiSO_4 7H_2O$	33 oz./gal.
$NiCl_2 6H_2O$	6 oz./gal.
H_3BO_3	3-4 oz./gal.
pH	2.5
Temperature	150° F.
Current density	90-100 amp./ft.²

LCP (7a)

The Electrodeposition of Tin from Solutions of Sodium Stannate. D. T. EWING & ALF. CLARK. *Michigan Engineering Experiment Station Bulletin* No. 43, Vol. 7, Feb. 1932, pages 3-14.

The advantages of Sn as a corrosion resisting material are pointed out and the various processes for its electrolytic deposition are briefly reviewed. The methods with basic solutions generally use sodium stannate; the paper investigates the influence of concentration, temperature, current densities and alkalinity, on the structure of the deposited Sn. With Sn anodes, a black insoluble substance is formed which can be prevented almost entirely by addition of NaOH and heating to 60° C. Fe anodes do not form this black substance, but on continued use a white product is formed which can also be prevented by NaOH. Sn plates formed at higher temperatures are more porous than those formed at room temperature; they also have a lighter color. The best current density is 1 amp./cm.² The presence of metallic salts in the solution has no marked effect on the character of the Sn deposit. The best concentration of the bath is 140 g. of sodium stannate per liter. Ha (7a)

Cause of Adherence of Electrodeposits. G. DUBPERNELL. *Monthly Review, American Electroplaters Society,* Vol. 19, Mar. 1932, pages 9-17.

Paper before Detroit Branch Meeting, Jan. 8, 1932. The author reviews various theories since 1873. Two of them are most important, (1) deposited metal and base metal are held together by molecular attraction (2) the deposited metal is interlocked into the base metal which is slightly etched before plating. For metals such as Ni, Cr, and Al which tend to become passive, a cathodic treatment in 10-20% HCl will improve the adherence between these metals and the deposited coating. LCP (7a)

Gold Solutions for Production Work. J. L. MERIGOLD. *Monthly Review, American Electroplaters Society,* Vol. 19, May 1932, pages 26-32.

Paper before Los Angeles Branch Annual Meeting, Mar. 12, 1932. 20 formulas for gold plating including immersion plating, salt-water plating, electroplating, combination of salt-water and electroplating, 14 K gold, green gold, rose gold, purple gold, brown gold, pink gold, gray gold, red gold and white gold. LCP (7a)

Deposit Chromium on Electric Appliances. F. A. MAURER. *Monthly Review, American Electroplaters Society,* May 1932, pages 21-26.

Paper before Los Angeles Branch Annual Meeting, Mar. 12, 1932. Operating details for applying a Cu-Ni-Cr coating on steel and cast-iron parts of electric flatiron are given. All parts have a rust-proofness equivalent to 8 hours salt spray test. LCP (7a)

Progress Report on Exposure Tests of Plated Coatings. P. C. STRAUSSER. *Monthly Review, American Electroplaters Society,* Vol. 19, Feb. 1932, pages 15-26; *Metal Industry,* N. Y., Vol. 30, Apr. 1932, pages 150-152.

Includes discussion. Paper before Rochester Convention, July 1931. The report describes preparations at Bureau of Standards for corrosion tests to be made on steel specimens variously plated with Ni, Cr, Zn, Cd and Cd-Zn alloy. The work is done under the joint auspices of American Electroplaters Society and American Society of Testing Materials. PRK + LCP (7a)

Anodic Phenomena in Cadmium Plating Solutions. G. SODERBERG. *Monthly Review, American Electroplaters Society,* Vol. 19, Feb. 1932, pages 9-15.

Paper before Rochester Convention, July 1931. Cadmium anodes in a cyanide cadmium plating bath become polarized at 20-30 amp./ft.², depending on free NaCN content. Anode current density remains practically constant, when anode polarization is increased from 0.2 to 3 volts. With Fe anodes, the anode polarization has a nearly fixed value of 1.9-2 volts. With a combination of Cd and Fe anodes, the Fe anodes do not function until Cd anodes become polarized, i.e., over 20 amp./ft.² Voltage necessary to discharge O at anodes is much higher than what is normal with Cd plating, using either Cd or Fe anodes. Carbonate content in Cd plating bath is increased by elevated temperature and by using Fe anodes, but not by using a combination of Cd and Fe anodes. LCP (7a)

Electrometallurgy (7b)

Electrochemistry and Electrometallurgy. Electrolytic Processes. H. J. T. ELLINGHAM. **Electrothermal Processes.** H. MOORE. *Journal Institution of Electrical Engineers,* Vol. 69, Jan. 1931, pages 185-192.

The paper presents a summary of the present state and recent developments of electrolytic processes as they are employed for the direct production of a metal from one of its compounds (oxide, sulphate, etc.) which has been separated or formed from the ore by other metallurgical operations (concentration, roasting, leaching, etc.); or or the separation of 2 metals from an alloy produced by furnace reduction; or for refining a crude metal obtained by furnace reduction. The processes are discussed at length with reference to the methods used in the extraction of Ni by the International Nickel Co. and the refining of Cu by several American companies. The paper on electrothermal processes deals with the electric furnaces for melting and heat treatment, the production of ferro-alloys, pig-iron, steel, fixation of atmospheric nitrogen and the temperature control of furnaces. A few installations are described. 36 references. Ha (7b)

The Electrolytic Metallurgy of Zinc. (La Metallurgy du Zinc par Voie Electrolytique.) L. C. STURBELLE. *Revue Universelle des Mines,* Series 8, Vol. 7, Feb. 15, 1932, pages 224-232.

After a historical review of the electrolytic production of Zn the 3 main processes now in operation are described, that is the Anaconda or Standard process, with a weak acid solution, the Tainton process with high acidity, and the Sturbelle process, with a medium acidity, now in use in Belgium. The extraction amounts to 87-88%, 90-92% and 94-98% respectively for the 3 methods. The cost of installation per ton per day production are 2,000,000 frs., 1,400,000 frs. and 1,000,000 frs. respectively. It is very important that the cost for electric current is low; the author figures $20.00 per HP per year. In Belgium there are still many residues left from smelting processes which are now worked over with profit by the new process. Ha (7b)

Preparation of Metallic Lanthanum Free From Iron and Silicon (Préparation de lanthane métallique exemt de fer et de silicum). FELIX TROMBE. *Comptes Rendus,* Vol. 194, May 9, 1932, pages 1653-1655.

A description has already been given of the method employed by the author for the preparation of metallic Ce (*Comptes Rendus,* Vol. 193, 1931, page 421). By using a similar method he has been able to obtain metallic La free from Fe and Si. The composition of the electrolytic bath used in these tests was as follows: 60% anhydrous lanthanum chloride, 35% KCl and 5% precipitated CaF_2. A carbon crucible served as anode. This crucible contained a quartz or fluorite crucible which served to receive the metal deposited upon the cathode and to prevent its contact with the carbon tube. At the center of the quartz crucible a rotating Mo cathode was placed. The upper part of this cathode was protected by means of a quartz or fluorite tube. The cathode rotated at a speed of about 1 turn per second. Such rotation is absolutely essential if homogeneity of the bath is to be insured. A temperature of between 960° and 980° C. was employed, and a current of about 12 amp./25 g. of lanthanum chloride was used. The voltage of the cell was 7 and the cathode current density about 4 amp./cm.² The metal obtained represented 65% of that contained in the bath. Spectrographic examination insured the absence of Ca, Al and Si in the metal. Metal prepared in a quartz crucible, however, contained 0.3-0.9% Si. The purest samples showed the following properties: melting point, 885° ± 5° C.; Brinell hardness, 36; density, 6.139. OWE (7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Coating Industry Recognizes Prestige of Deep, Side-Heated Galvanizing Pots. *Steel,* Vol. 90, Jan. 4, 1932, page 169.

Improvements in the galvanizing industry during 1931 include the development of a new flux and of a new bright-dip cleaning method, a wider use of deep kettle installations and the application of diffusion flame burners, the development of alloy coatings to protect zinc surfaces, and the use of vulcanized rubber and acid-proof brick for lining pickling tanks. Other developments of interest are a new line of continuous cleaning, rinsing and drying machinery, continuous pickling equipment, new pickling machinery made of acid-resisting parts, and new galvanizing machinery. Improvements in the vitreous coating industry for 1931 include greater workability of acid-resisting enamels, the development of a new metal cleaner, the development of a new color chart, the completion of a large enameled metal tile manufacturing plant, and the proposal to build first exterior porcelain enameled metal house. JN (8)

Aluminum Coated Iron. (Aluminiertes Eisen). A. Karsten. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Mar. 20, 1932, page 121.

The Schoop metal spray method is described as utilized for Al coating. Schoop previously melted the metals with gas, melting in an electric arc is now used. GN (8)

The Electrolytic Coating of Metals with Lead Peroxide and its Anti-Corrosion Properties. (Die elektrolytische Ueberziehung der Metalle mit Bleisuperoxyd und ihre Anti-Korrosions-Eigenschaften.) N. Isgarischew & A. Kuznezova. *Zeitschrift für Elektrochemie,* Vol. 37, July 1931, pages 359-362; *Tzvetnuie Metallui,* No. 4, Sept. 1931, pages 449-453.

Optimum conditions were investigated for obtaining electrolytically a continuous coating of lead peroxide which would protect Cu or Fe against corrosion and at the same time give them a good appearance. Preliminary experiments showed that the best coatings on Cu and brass are obtained at the concentration of NaOH-1.0 N and Pb - 10.5 g. of $Pb(OH)_2$ per liter of H_2O, using current density of 0.3 to 0.4 amps./in.^{2} at 60° C. However the coatings were not very tenacious and did not fill pores and pits on the surface of the metal. Influence of various organic and inorganic substances was investigated, and it was found that the addition of small amounts of resorcin, tannin, glucose, glycerine, hypochlorite, ammonium persulphate with glucose, perborate with glucose, result in black, tenacious and elastic coatings on Cu or brass surface. Fe or steel may also be coated after preliminary plating with Cu; good coatings may be obtained directly on cast Fe by adding small amounts of glucose (0.1%) and perborate (0.25%), or glucose and ammonium persulphate (0.25%). The coatings on Cu plates stood an indefinite number of bends without breaking; Fe plates without preliminary Cu plating stood 2-3 bends. Tests also showed that the coatings resist well the atmospheric, tap water and salt water corrosion. 5.0% H_2SO_4 does not affect the coating, but strong sulphuric and nitric acids diffuse through the coating and dissolve metal; coatings do not protect against strong HCl. BND (8)

Metallic Cementation of Ferrous Alloys (La Cémentation Métallique des Alliages Ferreux). Joseph Laissus. *Aciers Spéciaux, Métaux et Alliages,* Vol. 7, Feb. 1932, pages 43-51.

The author applies the term cementation to any mutual action of 2 solid metals or metalloids in view of their penetration of one into the body of the other metal. In 1894, Spring showed that certain metals can penetrate one into another by heating them together above the melting point of one of the metals. Masing, in 1909, confirmed the experience of Spring by thermal analysis, microscopic examination and also using the effect of variation in electric conductivity corresponding to the progressive formation of solid solutions. H. Weiss, in his doctorate thesis, 1923, was the first one to make a systematic study of this important problem of metallic cementation (Thése de doctorat, Paris, *Ann.de Chim.Gén.* Serie T. Vol. XIX, June 1923; *Revue de Métallurgie,* Jan. 1924). He used couples made of Cu as one part and Zn, Sn, Al, Sb, Fe, Hg, Au, Ni and Ag as the other part. The work of other investigators on diffusion of metals in Fe is also discussed. Laissus made a complete study on metallic cementation especially on diffusion of Cr, W, Mo, Ta, V, Co, B, Ti, Zr and U in Fe and steel. His plan of study consisted in: (a) Preliminary study of the equilibrium diagram, (b) Experimental realization of cementation, (c) Study of different factors of cementation, (d) Study of principal properties of products obtained, (e) Interpretation of results and conclusions. GTM (8)

Palladium Protective Decorative Leaf. *Brass World,* Vol. 28, Apr. 1932, page 81.

Pd leaf has been perfected by the American Platinum Works, Newark, N. J. for uses similar to those of Au leaf. A white leaf of non-oxidizing nature and of permanence is secured for use on wood, glass, metals, leather, etc. WHB (8)

Mottled Tin-Plates. J. C. Jones. *Engineering,* Vol. 132, Oct. 9, 1931, pages 455-456.

See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 12. LFM (8)

Rustless-Steel-Lined Copper Utensils are finished with Arc-Welded Edge. *Iron Age,* Vol. 128, Dec. 17, 1931, page 1555.

Description of a method of combining the high Cr-Ni alloy and Cu employed by the Joseph Heinrichs Corp., Long Island City. A liquid-tight joint on the edge is made by arc-welding. Utensils are highly desirable for cooking in hotels and restaurants. VSP (8)

The Electric Oxidation of Aluminum. (Die elektrische Oxydation des Aluminiums.) *Aluminium,* Vol. 14, Mar. 31, 1932, pages 3-5.

A very resistant oxide coating on Al and its alloys is produced by the Eloxal bath which contains oxalic and chromic acid at a temperature of 15-30° C. The oxide film consists of γ-oxide very finely distributed. A thickness of 20-30 thousandth mm. has a breakdown strength of 300-400 volts. On flexible surfaces the hydroxide is used instead of the γ-oxide. The different applications of oxidation are discussed. Ha (8)

Tests on "Duralplat." (Untersuchung von Duralplatblechen.) K. Schraivogel & K. O. Schmidt. *Zeitschrift für Metallkunde,* Vol. 24, Mar. 1932, pages 57-62.

A detailed study of the properties of "Duralplat" (duralumin clad with a surface layer of a Cu-free, corrosion-resisting, hardenable and high-strength Al alloy), including tensile curves, bending test data, Erichsen ductility data, corrosion data with the effect of corrosion on strength properties. Like "Alclad," "Duralplat" corrodes only in the surface layer. After 30-day accelerated corrosion attack, 9½ months in salt spray, and 5½ months in the Baltic, the properties of the underlying duralumin were found unaffected, though uncoated duralumin under the same conditions was affected after a very short time. RFM (8)

Surface Problems of Materials. (Oberflächen-Probleme bei Werkstoffen.) *Oberflächentechnik,* Vol. 9, Apr. 19, 1932, pages 81-82.

The methods of treating metallic surfaces so that they fulfill certain requirements are discussed and reviewed. Rolls which must keep their grip in spite of wear on the material passing through them should be very hard which is best obtained by alloying with Si. A corrosion-proof surface can be produced, besides the natural protecting films which some metals develop, by coating with "tornesite" or "herolithe" which adhere extremely firmly to the metal surface and do not shrink, tear or spall; they do not soften by heat. Metallic coatings should be very thin as they adhere better and generally give better protection than thicker ones; metals which are electrochemically baser than the material on which they are deposited give better protection; Cr platings are now used up to 2 mm. thick. To produce heat-proof surfaces use is made of the fact that Al diffuses several mm. into the surfaces of cast Fe and steel; these methods are "alitizing" and "alumetizing." To make surfaces of non-conductors electrically conducting spraying of metals is used to good advantage. Ha (8)

New Swedish Method of Surface Enrichment with Aluminum according to Johannson. (Neues schwedisches Aluminisierungsverfahren Johannsen.) *Die Röhrenindustrie,* Vol. 24, Jan. 29, 1931, pages 30-31.

Note on scaling tests with aluminized tubes of 0.15% C carried out by the Sanvikens Jernverks Aktiebolag. The tubes perfectly withstood scaling tests at 800° and 920° C. for 24 hours. More severe conditions at 990° C. and 96 hours testing time also proved a marked protection of the aluminum-coated areas. Micro-investigations of samples held between 500° and 900° C. revealed that at 750° C. micro-structural changes begin. Corrosion tests in HNO_3 showed contradictory results. Atmospheric corrosion tests on samples with and without an Al-coating, showed appreciable rusting of the unprotected tubes and no effect on the aluminized samples. Similar results were obtained with tests in the pickling department, Duffek Corrosion Tester and other laboratory tests. No information on the coating method itself is given. EF (8)

Brittleness of Zinc Coated Steel. J. S. Adelson. *Heat Treating & Forging,* Vol. 18, Mar. 1932, pages 180-183; *Blast Furnace & Steel Plant,* Vol. 20, May 1932, pages 430-432, 435.

Method of Zn deposition is not the basic cause of the brittleness of Zn-coated steel. It can develop in steel coated by any method of Zn application. Results of investigation carried out with S.A.E. 1010 steel indicate that this brittleness is generally the result of a combination of factors. These factors are presence of a coating of Zn, which penetrates into the grain boundaries of the steel; amount of cold work in the steel; heating the steel to 750°-950° F. during or subsequent to the application of Zn; prolonged heating cycle; strain in the steel during the heating period; and heterogeneity of the steel. To prevent or minimize this embrittlement, such precautions as are commercially possible should be taken during manufacture and during the service life of the material to eliminate effects of these factors. Although hot-dip galvanizing must be done within the critical temperature range, sherardizing temperatures should be controlled to maintain them outside the range. If the use of these temperatures is unavoidable, the steel should be annealed before the Zn is applied. Care should be exercised in subjecting the material to fatigue. MS (8)

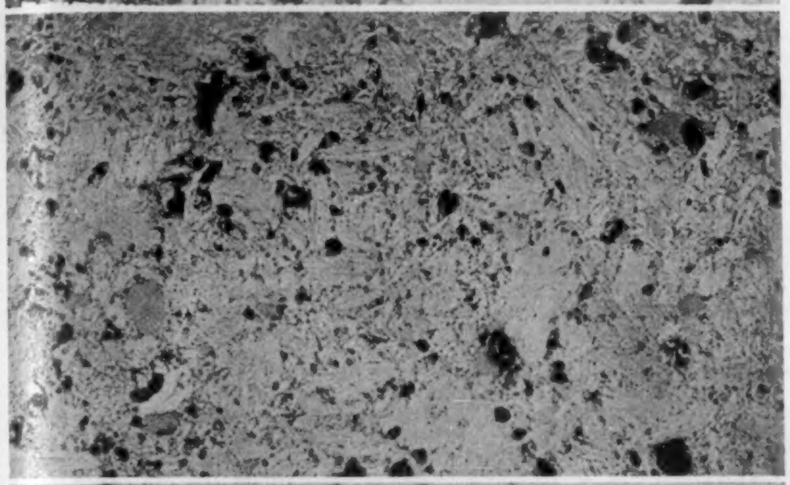
Corrosion-Resistant Material Made with Metallic Adhesive. A. W. Coffman (Mellon Institute of Industrial Research). *Chemical & Metallurgical Engineering,* Vol. 39, Mar. 1932, pages 144-145.

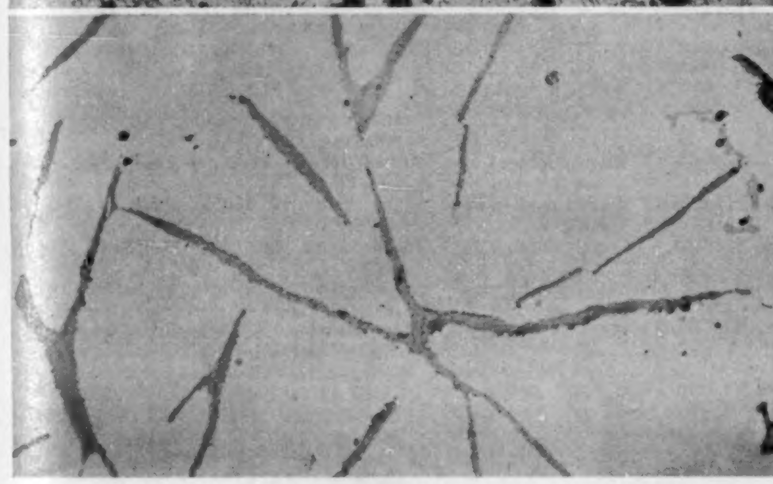
Descriptive of Robertson-Bonded-Metal, which in its finished form consists of 4 layers, any one of which may be changed to meet the corrosive conditions involved. They are (1) base metal, (2) metal adhesive of Zn, Pb, Sn or terne, etc., (3) felt or asbestos which may be saturated with a variety of materials to meet conditions of exposure, (4) waterproofing and decorative layer of paint, wood veneer, etc. PRK (8)

Cathode Sputtering, A Commercial Application. H. F. Furth. *Physics.* Vol. 2, Apr. 1932, pages 280-288.

Cathode sputtering cannot compete with the more common processes of metallic deposition, but in many special cases it can be employed where other methods are inapplicable. This is especially true (1) when metals are to be deposited upon non-conductors, (2) when the surfaces to be metallized would be injured by contact with chemical solutions or high temperature, (3) when either a very thin continuous metal coat or a very smooth, highly reflecting coat is desired, (4) when metals are to be deposited that are very difficult to deposit in any other manner, such as Si, Te, or Se, and (5) when a metal is to be deposited upon another metal far removed from it in the electrochemical series, such as Au or Pt upon Al or Mg. The theory of cathode sputtering with the advantages and limitations in the application is discussed, followed by a description of the commercial equipment and methods for applying Au electrode surfaces to diaphragms of certain types of microphones. By proper design of the vacuum chamber and the inside parts, a fairly uniform discharge current density and a uniform deposit is obtained. A constant sputtering rate is produced by the use of a bleeder valve which maintains a proper residual pressure. Adherence and continuity are obtained by the use of a special cleaning process. An extensive bibliography on cathode sputtering is included. WAT (8)

Readers' Comments—Continued





metallographic microscope or in the Leitz ore microscope, using polarized light. If cast iron is polished by the usual method it becomes difficult to observe the extinctions in polarized light.

I am further submitting a photomicrograph of a cast iron and a sample of Acheson graphite polished by the new method. This shows that graphite has a structure and is not black as had been supposed. The third photomicrograph is given merely as a matter of interest; it shows a particle of graphite surrounded by pearlite, the background being the carbide eutectic.

The above is not intended to detract from Mr. Vilella's worthy contribution but rather to strengthen his point of view.

University of Michigan, STEPHEN F. URBAN
Sept. 20, 1932.

To the Editor:—

I wish to extend my thanks to Mr. Urban and his associate Mr. Schneidewind for their pertinent and constructive comments on my article. It is indeed gratifying to know that my effort has received the approval of men who are themselves authors of a notable contribution on the same subject.

J. R. VILELLA

Sept. 25, 1932

Applications of Copper and Its Alloys in Buildings. (Les Applications du Cuivre et des ses Alliages dans le Batiment.) *Cuivre et Laiton,* Vol. 5, Feb. 29, 1932, pages 77-82; Mar. 15, 1932, pages 103-112.

The many applications of Cu for roofing, window sills, gutters and plumbing, apparatus and particularly for ornamental purposes are reviewed and economical advantages over other materials pointed out; a greater use in France is advocated. Ha (9)

Aluminum in Architecture and Structural Building. (Das Aluminium in der Architektur und im Bauwesen.) *Aluminium,* Vol. 14, Apr. 15, 1932, pages 5-6.

The advantages of Al against the usual metallic building material are pointed out among which are foremost the resistance to atmospheric influences, lightness, cheapness of machining due to high cutting velocities and long life. In addition, Al scrap has a much greater value than Fe scrap. Ha (9)

Results of the International Contest 1931 for the Development of the Consumption of Aluminum and Its Alloys (Ergebnisse des Internationalen Wettbewerbs 1931 für die Entwicklung des Verbrauches von Aluminium und seinen Legierungen). *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 4, Mar. 1932, pages 43-71.

The results of the first international competition for suggestions and methods to develop the use of Al are fully reported; the propositions comprise 28 different fields. The prizes were given to the authors of the use in tanning of leather and in the construction of radiators for central heating systems. The proposed applications in all 28 fields are described in detail and sketches illustrate the methods of use. The rules for the second competition in 1932 are reprinted. Ha (9)

Graphophone Records of Aluminum. (Grammophonplatten aus Aluminium.) *Aluminum,* Vol. 14, Mar. 31, 1932, pages 5-6.

Al discs are coated with a special lacquer into which the acoustic record is pressed. These records are said to be absolutely equal to the present shellac records. By heating to 80° C. the acoustic grooves disappear and a new record can be pressed on. The weight is about 50 g. against 200 g. of the usual record and the thickness 0.5 against 2 mm. Ha (9)

Copper Tubes in Domestic Plumbing. (Le Tube en Cuivre dans les canalisations d'eau domestiques.) *Cuivre et Laiton,* Vol. 5, Jan. 15, 1932, pages 7-12.

Commercial dimensions in France, Germany and Belgium are tabulated, tools and methods for cutting, threading, bending are illustrated, the different joints are explained and the economies possible by the use of Cu over other materials discussed. A list of 23 bibliographical references on this matter is added. Ha (9)

Pulp and Paper Engineers Discuss Materials of Construction. *Chemical & Metallurgical Engineering,* Vol. 39, Mar. 1932, pages 153-154.

Report of Meeting of Technical Association of Pulp & Paper Industry, Feb. 15, 1932. The following tabulates the results of the meeting:

Metal	Use	Service
18 Cr–8 Ni	Blowpit bottom	Satistactory after 3 years
	Relief strainer	Failed: using 85 Cu, 10 Sn, 5 Zn
	Fabricated Strainers	1 failure in 3 years
	Cast "	3 years
	Side relief valves	In use 2½ years: bronze fails in 3 months
	Digestor Castings	Better the higher the Cr for machining resists bisulphite liquor, hot SO_2 gas and waste liquor
	Digestor relief lines	4 years; occasional failure after installation
Copper	Top relief lines	Better than brass
Monel Metal	Stem of Blow valves	Better than acid resisting bronze
Iron pipe	Bleach lines	Suitable if filled
Wrought iron	" "	Good for 1 year
Cast Ni iron	" "	In service 3 years
Cast iron valves	" "	20 years
14 Ni, 6 Cu, 2 Cr, rest iron	Valves and pumps in digestors	Better than cast iron
Carbon	Sulphite and kraft digestors	Satisfactory
Lumber treated with zinc chloride	Roofs	Increases service life of untreated lumber 3-5 times

PRK (9)

Copper-Steel in the Manufacture of Hardware. (L'acier au cuivre dans la confection des serrures charmiéres et matériel simlaire). *Cuivre et Laiton,* Vol. 4, Aug. 30, 1931, page 387.

The advantages of non-rusting Cu steel in the manufacture of locks, hinges, chains and similar hardware is pointed out and its wider use is recommended. Ha (9)

Geared Motors. *Electrical Review,* Vol. 109, Dec. 11, 1931, pages 879-880.

Improvements in alloy steels have aided developments in modern reduction gearing. In one type of British geared motor, pinions aré made of nitralloy steel. In single-reduction units, final shaft is made from 3½% Ni steel having a tensile strength of 65 tons/in.[2] Units with double or treble reduction have compound shafts made from Ni-Cr-Mo steel having a tensile strength of 65 tons/in.[2] MS (9)

Wearing Parts of Crushing and Grinding Machinery. *Edgar Allen News,* Vol. 10, May 1932, pages 80-83.

A special Cr alloy steel is used for the wearing parts of ball mills, tube mills, rod mills, etc. They have the advantage of being more easily machined than Mn steel, have a high elastic ratio and a Brinell hardness of 255. Several parts and their details are illustrated. Ha (9)

Paper Milk Bottles (Bottighe du latte in cartone). *Alluminio,* Vol. 1, Jan.-Feb. 1932, pages 42-43.

Paraffined card board, Al foil lined milk bottles, used in Paris and Egypt, are illustrated. They are sterilized by ultra-violet rays. HWG (9)

HEAT TREATMENT (10)

Heat Treating Rivet Sets. Recommended Practices Committee A. S. S. T. *Metal Progress,* Vol. 21, Apr. 1932, page 67.

Tentative recommendations for forging, normalizing, tempering and annealing temperatures are made. Hardening temperature and medium are recommended with the hardnesses to be expected for plain carbon and alloy steels commonly used for rivet sets. WLC (10)

Deformation of Steel in Heat Treatment. PORTEVIN & SOURDILLON. *Iron Age,* Vol. 129, Feb. 25, 1932, page 492.

Abstract translation of article in *Revue de Metallurgie,* June and July 1931. Gives data from experiments conducted on exact measurement of changes as in the diameter, length and hardness produced in cylindrical specimens of various types of steel by different heat treatments. See "Deformations Accompanying Thermal Treatment of Steel," *Metals & Alloys,* Vol. 2, Nov. 1931, page 263. VSP (10)

Heat Treatment and Carburizing of Steel. (Tempera e cementazione dell' acciaio.) MARIO LEVI-MALVANO. Ulrico Hoepli, Milan, 1929. 2nd edition. Board covers, 4¼ x 6¼ inches, 306 pages. Price 20 lire.

The book starts with a discussion of equilibrium diagrams in general, then discusses the Fe-C diagram, and so leads up to the theory and practice of heat-treating and carburizing. Furnaces and pyrometry are dealt with, there is a chapter on macro-etching, and the volume ends with a description of the metallurgical laboratory at the Instituto Scientifico Breda at Milan.

A good deal of recent work is included, and credited to various workers, but there are no literature references and no alphabetical index.

The keynote of the little volume is the application of theory to practice. The fundamentals are quite well brought out. H. W. Gillett (10)-B-

Hardening (10a)

Treating Parts for Non-Uniform Hardness. *Metal Progress,* Vol. 21, Mar. 1932, pages 47-52.

A description of differential hardening practice and equipment at the River Rouge plant of Ford Motor Co. Selective heating by means of low voltage currents of high amperage is being used successfully. Differential quenching by means of jets of coolant (principally caustic solution 10° Beaumé at 85° F.) is also employed. WLC (10a)

Difficult Hardening. (Schwierige Härtungen.) A. NAUCK. *Das Werkzeug,* Supplement to *Maschinenbaukonstrukteur-Betriebstechnik,* Vol. 8, Feb. 10, 1932, pages 26-27.

Considers the continuous hardening of wires; the hardness of bearings, of low-C steel, of small steel rolls, of complex tools, and of oscillating steel strips; partial hardening; the hardness of rapidly revolving pistons; cooling of hollow shapes; hardening in the lead bath; heating for hardness. MAB (10a)

Investigation of Steel Hardening. (Untersuchungen über die Stahlhärtung.) NIELS ENGEL. Ingeniroidenskabelige Skifter A No. 31, Danmarks Naturvidenskabelige Samfund, Kbenhavn, 1931. Paper, 6½ x 9¾ inches, 190 pages. Price 10 Kroners.

It is by reading monographs as this that it is realized how much even of very familiar phenomena still remains to be explained although practice may already have arrived at a fairly high grade of perfection. The present work treats the hardening process of steel of which so much has been written and yet it seems that all prescriptions and recipes to obtain an excellent product, rest more or less on an empirical basis. This was the reason for the author starting a thorough investigation to find what really constitutes the hardening of steel. We know that the steel must be converted into an austenitic structure for a successful hardening process, and how this can be done is the principal question bound up with the thermal phenomena of cooling and quenching. Quenching is defined as a cooling of a metal in such manner that those physical phenomena which would take place at slow cooling are suppressed either entirely or partially because they do not have time to develop fully. For this reason the cooling process is of prime importance. The author treats, consequently, first the process of quenching, second the importance of the cooling velocity in the hardening of steel. From these 2 studies he then tries to develop a theory of hardening which would put the practical steel man in a position to understand his problems so clearly that for each individual case he can find the proper solution. A diagram is developed showing the 4 possible conversions of austenite of which only 3 are of importance to hardening and indicating the formation velocity of the conversion as a function of temperature. The hardness is bound up with a certain arrangement of the carbon atoms in the lattice in such form that the sliding planes are blocked and prevent a deformation of the lattice structure formed in the hardening process. Based on these results the changes of physical properties due to hardening are explained in the last chapter. A number of diagrams illustrating these results are reproduced in 8 plates. The book is written in simple, clear language, and should be on the desk of every practical steel man. M. Hartenheim (10a)-B-

Electric Hardening of High Speed Steel. A Consideration of the Factors Influencing the Heat-Treatment of High Speed Steel in relation to the Type of Plant Used. A. G. ROBIETTE. *Iron & Steel Industry & British Foundryman,* Vol. 5, Jan. 1932, pages 171-177.

A discussion of the theoretical considerations present in the hardening of high speed steel. The use of salt baths is given preference over box-type electric furnaces. A new design in salt baths is described in which the passage of current through the pieces being hardened is eliminated by placing the electrodes close together on one side of the bath so that the working portion of the bath is kept distinct from the heating zone. CHL (10a)

CASE HARDENING & NITROGEN HARDENING (10c)

Contribution to the Knowledge of Metal Nitrides. (Beiträge zur Kenntnis der Metallnitride.) JEAN RIEBER. Doctor's thesis, Technische Hochschule Hannover, 1930. Paper, 45 pages.

The chief purpose of this study was the preparation of pure nitrides of the following metals: Mg, Ca, Sr, Ba, Be, Al, B, Ti, Fe, Zr and Cu.

A general review of the previous work done by other investigators on preparation of nitrides, introduces this study.

Experimental work is then discussed in detail. The author used purified nitrogen gas and ammonia as sources of nitrogen. Pure nitrogen was prepared by passing the nitrogen from the tank through a purifying train consisting of (a) heated copper chips, (b) alkaline solution of hydrosulphite, (c) H_2SO_4, (d) P_2O_5.

Ammonia gas was purified by passing over soda lime, Na metal and then condensed at -78° C.

The method of preparation of each nitride varies with the metal; from the detailed description of preparation and of the results obtained the following table would illustrate the main points of this work.

TABLE I. PREPARATION OF METAL NITRIDES

Metal Nitrides and % of Nitrogen	Source of Metal and of Nitrogen	Treatment	Product Obtained and % of Nitrogen
Mg_3N_2 (27.72)	Mg, Metal (99.7%); N_2, gas	4-5 hours at 800-850°C.	Mg_3N_2 (27.67; 27.84; 27.69% N)
Mg_3N_2	Mg, Metal; NH_3, gas	2 hours at 800-850°C., then cooled in stream of ammonia	$Mg_3N_2.xNH_3$ (29.84 to 38% N)
Ca_3N_2 (18.89)	Ca, metal; N_2, gas	16 hours at 800°C. then 4 hours at 1000°C.	Ca_3N_2 (18.31-18.69% N)
Ca_3N_2	Ca, metal; NH_3, gas	16 hours at 850-900°C. and then for 1 hour at 1150° C. with a slow cooling in stream of ammonia	$Ca_3N_2.xNH_3$ (20.86-22.82% N)
Sr_3N_2 (9.63)	Sr, metal; N_2, gas	5 hours at 850-900°C.	Sr_3N_2 (9.34% N)
Sr_3N_2	Sr, metal; NH_3, gas	3 hours at 850-900°C. and then cooled during 2½ hours in stream of ammonia	$Sr_3N_2.xNH_3$ (11.7% N)
Ba_3N_2 (6.36)	Ba, metal; N_2, gas	5-6 hours at 500-550°C.	Ba_3N_2 (7.27% N)
Ba_3N_2	Ba, metal; NH_3, gas	5-6 hours at 700°C.	$Ba_3N_2.xNH_3$ (13.8% N)
Be_3N_2 (50.66)	Be, metal; N_2, gas	Long Heating at 1000° to 1100°C.	Be_3N_2 (45% N)
Be_3N_2	Be, metal; NH_3, gas	12 hours at 950°C. and then 2½ hours at 1050°C.	Be_3N_2 (49% N)
AlN (34.08)	Al, metal; N_2, gas or NH_3, gas	At 800-860°C. for few hours	AlN (33.36% N)
BN (56.4)	Borax, NH_4Cl	Heat borax for 6 hours at 800-850°C. then pure NH_4Cl is added and heated for 10 minutes	BN (56.08% N)
Fe_yN_x	Freshly reduced Iron and N_2	Heated for 20 hours at 700°C.	Fe_yN_x (0.2-0.3% N)
Fe_2N (11.15)	Freshly reduced Fe; NH_3	15-20 hours at 450°C.	Fe_2N (10.6% N)
Fe_5N_2 (9.73)	Freshly reduced Fe; NH_3	15-20 hours at 475-500°C.	Fe_5N_2 (9.21% N)
Fe_yN_x	$FeCl_2$-$2H_2O$; NH_3	4 hours at 630-650°C.	Fe_yN_x (6.35% N)
	$FeCl_2$ subl.; NH_3	3 hours at 700° C.	Fe_yN_x (4.7% N)
	$FeBr_2$-H_2O; NH_3	2½ hours at 680°C., this product was magnetic. After 20 more hours at 450-475°C. This product took up more nitrogen	Fe_yN_x (8.1% N) Fe_yN_x (10.0% N)
	$FeCl_2$-$2H_2O$; NH_3	2 hours at 700°C.; magnetic	Fe_yN_x (6.0% N)
	$FeCl_2$-subl.	2 hours at 700°C.; magnetic	Fe_yN_x (3.6% N)
	$FeCl_2$-subl.	3½ hours at 630-650° C.; magnetic	Fe_yN_x (6.94% N)
Fe_2N (11.15)		After 48 more hours at 450°C.; non-magnetic	Fe_2N (10.6% N)
Fe_4N (5.90)	Fe_2N	Heating Fe_2N at 550°C.	Fe_4N (5.9% N)
TiN (22.56)	$TiCl_4$; NH_3	10 hours at 1200°-1300°C.	TiN (22.21% N)
ZrN (13.39)	Zr, metal; NH_3	5 hours at 1100-1200°C.	ZrN (12.42% N)

Copper nitride cannot be obtained in pure form, it usually contains two other elements such as hydrogen and oxygen.

Temperature of decomposition of some of these nitrides has been determined. Be_3N_2, BN, TiN, ZrN decompose above 1100° C., Mg_3N_2 at 1150° C.; Cr_3N_2, Br_3N_2, and Sr_3N_2 above 1100° C.; AlN above 1400° C.; Fe_4N at 650° C.; Fe_2 N at 550° C., and Fe_5N_2 at 750° C. G.T.Motok (10c) -B-

Quenching (10d)

New Results of the Influence of Quenching in Water on Mild Steels. (Nouveaux Résultats sur la Trempe à l'Eau des Aciers Doux.) J. SEIGLE. *Génie Civil,* Vol. 99, Oct. 17, 1931, pages 395-398.

The author summarizes the results of a thesis by Allan Bates on the effect of quenching on the strength of mild steels as a function of the quenching temperature and of the time elapsed after quenching. The hardening effect of quenching increases considerably during the first 3 or 4 weeks after quenching; equilibrium diagrams and microphotographs are discussed and it is stated that the aging can be explained by a precipitation of cementite particles which are very fine and invisible with our present appliances; this precipitation goes on during the whole time of aging. Ha (10d)

Drawing (10e)

Drawing of High Speed Steels. (Etude sur la revenue des aciers à coupe rapide.) André Michel & Pierre Benazet. *Revue de Métallurgie*, Vol. 29, May 1932, pages 259-275.

Conclusions of Sagasawa (*Revue de Métallurgie*, Vol. 20, Jan. 1925, page 92) regarding the decomposition of austenite in quenched high speed steel into austenite and martensite on drawing from moderately high temperatures were confirmed. It was found that for these steels containing large amounts of Co and quenched into austenitic state the first drawing does not destroy all austenite. The transformation and increase of hardness continue on the subsequent draws, provided that the soaking time is normal. This investigation was conducted on steels containing approximately 0.72-0.80 C, 5.0-5.6 Cr, 18-19 W, 1.0-1.5 V to which different amounts of Co were added. More than 5% Co facilitates the austenitic structure on quenching. On cooling from not too high temperatures and normal soaking time the γ-α transformation occurs under about 250° C. but with greater than 10% Co content the decomposition becomes more sluggish and for proper hardening several draws are required. This was checked with a dilatometer and by cutting tests. Longer soaking results in some decomposition of austenite. 4 hours at 600° C. slightly increase the transformation on cooling. For complete hardening on drawing a steel with not more than 11% Co 24 hours at this temperature are sufficient with a single draw. At 660° C. 2 hours soaking will lead to complete hardening on cooling of steels containing not more than 17% Co while longer soaking at the same temperature permitted all steels which have been investigated to harden fully on a single draw. Isothermal heating at 600° C. for 24 hours did not show any appreciable effect on steels having up to 11% Co, though it appears that with 20% Co the transformation is somewhat easier. Soaking at 650° C. for 2 hours caused some decomposition in all steels investigated, but the resultant hardness is lower than with the usual draw. Some evidence is presented to support Tammann and Erich Scheil conclusions that these irregularities in drawing phenomena are connected with the pressure exerted by the formation of martensite. See also *Metals & Alloys*, Vol. 2, July 1931, page 132. JDG (10e)

Time Factor in Tempering Dies. Bernard Thomas. *Heat Treating & Forging*, Vol. 18, Jan. 1932, pages 35-38.

2 objectives aimed at in tempering are removal of stresses and production of particular physical structures. In general, the first objective occupies a minor part in the function of tempering, and it is the second which needs time to be achieved successfully. This factor of time is of great importance because of the necessity of formation of the physical structures and properties for best results and because of the size of the article being treated. To obtain the best results from a tempering operation, it is necessary to determine the most suitable physical structure or combination of structures. Having decided this point either by experience or investigation, the necessary approximate temperature may be determined. Using too high a temperature even for a short time will produce inferior results. MS (10e)

Aging (10f)

The Aging of Hardened Carbon Steel. *Metallurgist*, Sept. 1931, pages 131-132.

An extended abstract of a paper by Steinberg & Subow appearing in *Stahl und Eisen*, Vol. 51, July 16, 1931. See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 42. VVK (10f)

Age Hardening Phenomena in Typical-Fusion-Weld Metal. F. R. Hensel & E. I. Larsen. *Transactions, American Society for Steel Treating*, Vol. 19, May 1932, pages 639-672.

Includes 16 references and discussion. The authors report study of the age hardening phenomena in weld metal due to presence of precipitating nitrides of Fe. Arc and gas welds of low C steel and ingot iron are compared. A maximum of 0.05% N_2 must be held if satisfactory ductility is to be maintained. Arc welds contain 0.10 to 0.15% N_2 and show pronounced age hardening; after quenching at 1110° F. aging proceeds at room temperature. Gas and atomic hydrogen welds produce superior welds with bare wire showing only negligible embrittlement due to aging. All types of weld metal showed extreme "abnormality" according to the McQuaid-Ehn test. Data on the effect of the age hardening properties of such weld metal on its magnetic properties and electrical resistance are presented. Micrographs show the structures observed in the welds studied. WLC (10f)

The Age-Hardening of Alloys. C. H. Desch. *Sibley Journal of Engineering*, Vol. 46, Mar. 1932, pages 65, 66, 83.

The general principles of precipitation hardening are discussed, with the Al-$CuAl_2$ and Fe-Fe_4N diagrams as examples. The development of Lüders' lines revealed in a mild steel tensile specimen slightly stretched, heated to 200° C. by etching in an acid Cu solution is said to be entirely due to the presence of N and steels too low in N to show age-hardening do not show the effect. Precipitation of nitride in and resultant brittleness of boiler steel during operation are stated to account for certain instances of boiler failures. HWG (10f)

Aging in Low-Carbon Steels. A. Allen Bates. *Transactions American Society for Steel Treating*, Vol. 19, Mar. 1932, pages 449-480.

Includes discussion. See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 15. WLC (10f)

Precipitation Hardening with Special Reference to Experiences Gained on Light Metals and Alloys of Beryllium. (Ausscheidungshärtung-Vergütung insbesonders auf Grund der Erfahrungen an Leichtmetallen und an Legierungen des Berylliums.) G. Masing. *Die Metallbörse*, Vol. 21, June 13, 1931, page 1110.

Summarizes a lecture at the 36th General Meeting of the Deutsche Bunsengesellschaft für angewandte physikalische Chemie, Vienna, 1931. See *Metals & Alloys*, Vol. 3, June 1932, page MA 174. EF (10f)

Improvement of High-Alloy Austenitic Nickel-Chrome Steel by Carbide Precipitation Hardening. E. Greulich. *Foundry Trade Journal*, Vol. 46, Mar. 31, 1932, page 208.

Abstract of a paper which appeared in *Archiv für Eisenhüttenwesen*. See *Metals & Alloys*, Vol. 3, June 1932, page MA 174. OWE (10f)

The Age-Hardening of Some Aluminum Alloys of High Purity. Marie L. V. Gayler & G. D. Preston (National Physical Laboratory). *Institute of Metals, Advance Copy* No. 591, Mar. 1932, 12 pages.

The effects of several elements on the age-hardening properties of Al alloys containing 4% Cu were investigated. Highly pure Al (99.96%) was used in preparing the alloys. It was found that 0.35% Fe inhibited age hardening at room temperature. This effect is partly counteracted by 0.25% Si, and is entirely eliminated by 0.5% Mg. X-ray and microscopic examination failed to indicate the mechanism of hardening at room temperature. It is suggested that age hardening of Duralumin at room temperature and at 200° C. is due to the same process, and that this hardening occurs prior to the actual precipitation of $CuAl_2$ or Mg_2Si. It is also suggested that both $CuAl_2$ and Mg_2Si are effective in hardening Duralumin. 11 references. JLG (10f)

The Course of Aging of Mild Steel and the Aging of Steels of Different Origin. (Ueber den zeitlichen Verlauf der Alterung weichen Stahls und über die alterung von Stählen verschiedener Herkunft.) V. v. Koeckritz. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Akt.-ges. Dortmund*, Vol. 2, No. 9, 1932, pages 193-222.

That phenomenon which causes an increase in the resistance of steels to deformation and a decrease in their capacity for deformation is generally called aging. For practical purposes the increased brittleness manifested in the notch-impact test is of special importance. A great number of tests were made to find the changes in aging for different manners of treatment of the steel, for instance, by interrupted tests where freshly made steels were subjected to loads up to a certain stress, then relieved and aged and again subjected to the same stress to final fracture and this at different temperatures. The fact that the course of tensile properties is parallel with certain hardening phenomena was demonstrated. Because of this fact the cause of aging is ascribed to the segregation or precipitation of a certain material or matter, the nature of which is as yet unknown. The similarity of changes due to aging and to hardening makes this assumption very probable. A magnetic analysis did not supply an explanation for the aging phenomenon although this fact does not contradict the previously described theory of aging as the segregations strongly influence the magnetic quantities by cold deformation. The tests made on a very great number of steels indicate the probability that 0 in the form of soluble oxide might be the originator of aging as of all steels tested Armco iron and Thomas steel show the strongest aging phenomena and these 2 steels contain the greatest amount of 0 due to their method of manufacture. For further details the paper with its tables and curves must be referred to. 35 references. Ha (10f)

Experiments on the Aging and Tempering of Duralumin. R. Hay. *Journal Royal Technical College* (Glasgow), Vol. 2, Jan. 1932, pages 601-608.

The view is expressed that the aging of duralumin alloys is due to the concentration of the solute at the grain boundaries and that tempering is brought about by precipitation resulting from supersaturation. The tempering curves obtained for duralumin are similar to those found for steels and can be expressed by the same general equation. In the phenomenon of age-hardening at least 2 independent factors occur. At low temperatures a gradual but uniform change in the properties occurs, and this change can be accounted for by the deposition of the particles of the separating phase in a highly disperse state. As the separating phase consists of aggregates of several molecules, diffusion must have occurred. Whether it is necessary for actual precipitation to occur is a debatable point as the observed phenomena can be accounted for by the concentration of the separating phase at the grain boundaries without actual precipitation occurring. The change at the higher temperatures involves, on the first assumption, the gradual coalescence of the disperse particles and, on the second assumption, the gradual precipitation of the concentrated phase at the grain boundaries. The experiments on tempering show that this second factor takes place in a series of steps, rapidly reaching a stable state for each temperature of tempering. This stepped equilibrium is more difficult to explain by the coalescence theory than by the precipitation at the grain boundary theory. By the latter the increased temperature will cause more rapid diffusion of the solute phase to the grain boundary so causing excessive concentration and precipitation of the excess material until a state of equilibrium is once again attained. A further increase of temperature will again upset the balance causing more solute to go to the boundaries and resulting in further deposition. WAT (10f)

Precipitation Hardening and Its Possibilities of Application. (Die Ausscheidungshärtung und ihre Anwendungsmöglichkeiten.) E. Dorgerloh. *Maschinenbau*, Vol. 11, Jan. 7, 1932, pages 5-7.

Rather complete descriptive account of the development in precipitation hardening theory and practice. Refers both to non-ferrous metals and to iron and its alloys. The article is particularly valuable on account of its giving extensive data of quenching and drawing temperatures and of the resulting hardness characteristic of the various metals. The designer's attention is called to the peculiar advantages of this type of hardening in comparison to quenching and other kinds of hardening. In this regard, the still maintained easy workability, the lack of internal stresses and prevention of hair cracks and within certain limits—the ease in obtaining special properties desired are mentioned. It is made possible to fully obtain a required hardness even in dealing with larger forgings or castings of complicated shape. A great number of references is cited. RFV (10f)

JOINING OF METALS & ALLOYS (11)

Welding & Cutting (11c)

Training Gas Welders for the Job. T. M. JONES. *Paper presented to the 32nd Annual Convention of the International Acetylene Association*, Chicago, Nov. 1931, 5 pages.
Outlines a plan of training consisting in selection of suitable material for training, development of the individual, and thorough practical instruction. Ha (11c)

The Welding of Electron Metal. (Die Schweissung von Elektronmetall.) H. A. HORN & K. TEWES. *Technisches Zentralblatt*, Vol. 41, Mar. 1931, pages 249-253; April 1931, pages 318-320.
Cast electron metal and the rolled material AM503 can be welded very satisfactorily. The welding rod must be of the same material, and the oxy-acetylene flame is the best suited. A Mg flux should be used which can easily be washed off later to avoid corrosion. Cast pieces of electron must be preheated. Microphotographs show the structure of electron welds. Ha (11c)

Methods in Fusion Welding. (Arbeitsverfahren in der Autogentechnik.) H. HOLLER. *Technisches Zentralblatt*, Vol. 41, Feb. 1931, pages 123-126.
The methods of left- and right-hand welding (Progressing and retrogressing) are explained and the advantages of both compared. The distance between 2 sheets depends on the length of the seam and the thickness of the sheets. General instructions are given. Ha (11c)

Electro-Welding in Reinforced Concrete Construction. (Die Elektroschweissung im Eisenbetonbau.) R. HOFFMANN. *Zement*, Vol. 20, Nov. 26, 1931, pages 1024-1026; Dec. 3, 1931, pages 1041-1042.
Data on amperage, voltage, power consumption, efficiency, electrode dimensions of electro welding. Then the particular welding performances are discussed which are required on the skeleton of reinforced concrete work with reference to (1) the proposal of Bondy, i.e., a casing with welded rims and welded slits, (2) the writer's suggestion, i.e., the use of a split casing with welded edges and longitudinal seam, (3) lap welded joint, and (4) stitched welded joint as a substitute for interwoven joints. Among the utilization of electro welding in reinforced concrete structural work, the application to the patents of Bauer is emphasized. Results from tests on welded rods are presented. EF (11c)

The Oxy-Acetylene-Welding of High-Grade Materials. (Die Azetylen-Sauerstoff-Schweissung hochwertiger Werkstoffe.) W. HOFFMAN. *Autogene Metallbearbeitung*. Vol. 25, Feb. 15, 1932, pages 49-52.
As a first requirement for a satisfactory weld of high-grade materials, especially structural steels St 34, St 37, St 52 (German standards) it is necessary that the added material have 100% of the static tensile properties of the piece itself. Several plain and alloyed welding wires are investigated in this respect. By proper selection of the welding wire, all high-grade steels for building can nowadays be welded by the gas-fusion welding method. Diagrams of endurance tests of welded and not welded materials are shown. Ha (11c)

Fusion Welding of Bodies of Vessels. (Autogen-Schweissung von Schiffskörpern.) HOELZERMANN. *Schmelzschweissung*, Vol. 11, Feb. 1932, pages 27-29.
Experience has shown that fusion welding can very well take the place of riveting for large parts without fear of warping deformation if the proper welding methods are applied. The costs for welding are lower than for riveting. Ha (11c)

Recent Development in Piping and Pipe Fittings for Welded Construction. S. HIRSCHBERG. *Paper read before the 32nd Annual Convention, International Acetylene Association, Chicago,* Nov. 1931, 9 pages.
The advantages of welded fittings which now are admitted by the A. S. M. E. Boiler Code, are pointed out and the design of pipe joints, elbows and tees, expansion bends, valves and headers and their manufacture briefly described. Ha (11c)

Adoption of Welding in Superstructure and Bridge Constructions made of Reinforced Concrete. (Anwendung der Schweissmethoden bei Hoch- und Brüchenbauten in Eisenbeton.) O. BONDY. *Zement*, Vol. 20, Aug. 20, 1931, pages 781-784.
The recent injection of welding into reinforced concrete structural work is demonstrated. Furthermore the writer touches upon the utilization of welding for iron skeletons of columns, the application to the patents of Bauer and the adoption of welding in making flexible steel fabric. Mentions in conclusion the different welding methods. EF (11c)

Are Welding in American and German Ship Yards. (Lichtbogenschweissung auf Werften in Amerika und in Deutschland.) LOTTMANN. *Werft, Reederei und Hafen*, Vol. 11, Sept. 7, 1930, pages 368-372.
The rapid progress of arc welding in ship building in both countries is reviewed. The information on the status of welding in the U. S. A. mainly refers to statements of J. W. Owens, Newport News. EF (11c)

What an Engineering Graduate Should Know about Welding. E. LUNN. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 5 pages.
General remarks on a curriculum recommended. Ha (11c)

Application of Gas Welding on Nickel Plate Road. J. C. MILLER. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 6 pages; *Journal American Welding Society*, Vol. 11, Jan. 1932, pages 32-34.
The author describes repair of locomotive frames, cylinders, guides, stoker screws, certain parts of cars, battered rail ends and worn frogs by means of the oxy-acetylene welding process. Use of the oxy-acetylene cutting torch in the railway shop is also discussed. Detailed procedures and estimated savings are given. Ha+TEJ (11c)

Discussion of Paper on "Welding of Piping in New York Hospital—Cornell Medical Clinic" by C. J. THALE. *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 29-30.
Discussion of paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in Journal of the American Welding Society, Vol. 10, Oct. 1931, pages 43-44. See *Metals & Alloys*, Vol. 3, Apr. 1932, page MA 98. TEJ (11c)

Code for the Welded Construction of Low Pressure Tankage. *Journal American Welding Society*, Vol. 11, Jan. 1932, pages 35-38.
Outline of proposed code covering the manufacture of stationary low pressure welded tanks for installation in buildings, prepared by the American Welding Society Committee on Building Codes. Excerpts of the Minneapolis Building Code pertaining to storage tanks, are also included. TEJ (11c)

Welding Applied to Aircraft Construction. P. F. TAYLOR. *Welding Journal*, Vol. 29, Jan. 1932, pages 18-20; Feb. 1932, pages 38-40.
Paper read before the North-Western Branch of the Institution of Welding Engineers, Jan. 1932. Welding has been successfully applied to aircraft since 1913. The author cites the advantages of welded construction. The most suitable composition of straight C steel for welded aircraft construction is: C 0.15-0.18%, Mn 0.30-0.50%, Si 0.30 max., S 0.04 max., P 0.04 max. A high Mn steel, containing 0.25-0.35% C and 1.5% Mn is used in some cases. Cr-Mo steel is the most suitable because of its high strength and toughness. This steel contains: C 0.25-0.35%, Mn 0.50%, Cr 0.80-1.00%, Mo 0.18-0.25%. A suitable welding rod contains: C 0.07%, Mn 0.28%, Si 0.015%, S 0.02%, P 0.02%. Procedure for welding Al is given as well as the composition of a suitable flux. Stainless steels for welding purposes should be of the austenitic type which contain 7 to 12% Ni and 14 to 20% Cr. A filling wire having a slightly higher Cr content is desirable. The author describes the proper welding procedure for this type of steel. Part II. The author discusses various oxy-acetylene welding defects, their causes and prevention. Unavoidable volume changes during welding are explained. The physical condition of a weld is improved by subsequent heat treatment. After describing the different types of joints used in aircraft welding, the author gives general rules for making repairs in welded structures. Precautions must be taken in order to minimize distortion. Procedure is outlined for the building of a typical welded steel fuselage. TEJ (11c)

The Effect of the New Welding Code on Process Industries, and the Importance of Its Proper Application. F. G. SHERBONDY. *Journal American Welding Society*, Vol. 11, Feb. 1932, pages 28-29.
Paper presented at a joint meeting of the Metropolitan Sections of the A.S.M.E. and A.W.S. The universal approval that has been accorded welded construction is, according to the author, chiefly due to: (1) The long-felt need for vessels of superior construction, (2) The thoroughness with which various welding procedures have been worked out, (3) The coöperation of various organizations in unifying the various methods of welding into a universal code. This code may not always be understood and the proper class of welding may not always be specified. The author explains the classification of the A.S.M.E. code for welding pressure vessels and makes other pertinent comments on the subject of stress relieving. TEJ (11c)

Factors Affecting Welding of Alloy Steel. WILLIAM SPRARAGEN. *Electrical World*, Vol. 90, Jan. 23, 1932, pages 180-181.
Cr-Ni alloy steels are more readily welded than Cr alloys with Ni. Certain physical properties of the Cr-Ni alloys with less than 0.5% C must be considered in welding operations. Some possess but 1/3 of the heat conductivity of ordinary steels, while having an expansion coefficient about 50% greater than that of steel. For arc-welding of these corrosion-resisting steels a coated electrode is an absolute necessity. Reverse polarity is employed because the electrode is made the positive side and the work the negative terminal. Satisfactory welds have been produced with a C-arc shielded by a hydrogen atmosphere in many of the alloy steels. The gas mixture is usually 75% N and 25% H. WHB (11c)

Welding and the Heating, Piping and Air Conditioning Industry. L. B. SPAFFORD. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 8 pages.
The field of municipal and cross-country piping is reviewed and the materials now transported by piping compared with those transported by rail. The economic advantages, even necessity is discussed and shown how welding meets the requirements. Ha (11c)

Transformer Cases are Flash Welded. H. W. TOBY. *Welding*, Vol. 3, Jan. 1932, pages 27-29.
Description of transformer tank fabrication by the flash welding process. TEJ (11c)

Giving the Weld a Chance. G. E. THORNTON. *Journal American Welding Society*, Vol. 11, Feb. 1932, pages 9-10.
Article prepared as a report to the Fundamental Research Committee of the American Bureau of Welding. The usual test specimens used for determining the endurance of metals all contain a critical section at which the majority of the specimens break when tested in fatigue. If the weld is located at this critical section, the test does not show whether the weld is stronger or weaker than the stock metal in fatigue. The author suggests a constant strength specimen which abolishes the critical section and allows a stress to be applied which will be the same stress per unit of cross section at any point in the specimen. TEJ (11c)

Welding in Ship Building. (Schmelzschweissung im Schiffbau.) TEUBERT. *Werft, Reederei und Hafen*, Vol. 12, May 15, 1931, pages 164-166.
Report on a Discussion Meeting of the Schiffbautechnische Gesellschaft, Berlin, 1931, in connection with a lecture on "Construction Principles and Actual Accomplishment of Electro-Welding in Ship Building." EF (11c)

Welded Tips for High Speed Tools. THOMAS K. VINCENT. *Welding*, Vol. 3, Jan. 1932, pages 22-25.
Experiments in tipping high speed tools with cutting material by means of the electric arc and oxy-acetylene welding processes indicate that this method has a field in the manufacture of emergency or special tools. TEJ (11c)

One-Piece Construction Improves Condensers. C. M. TAYLOR. *Power*, Vol. 75, Mar. 22, 1932, page 442.
An arc-welded condenser is illustrated and described. AHE (11c)

Discussion of Paper on "The Yale University Group of Welded Buildings" by GILBERT D. FISH. *Journal American Welding Society*, Vol. 10, Dec. 1931, pages 8-11.
Discussion of paper presented at Fall Meeting of American Welding Society in Boston, Sept. 1931, and published in *Journal American Welding Society*, Vol. 10, Oct. 1931, pages 9-12. See *Metals & Alloys*, Vol. 3, Apr. 1932, page MA 100. TEJ (11c)

WORKING OF METALS & ALLOYS (12)

Drawing & Stamping (12h)

The Production of Sheet Metal Containers. Part III. S. D. Brootzkoos. *Metal Stampings,* Vol. 4, June 1931, pages 509-512.

Describes the modern automatic double seaming machine which attaches the bottoms to the can bodies at a rate of 300 cans/hr. and describes the steps in the operation of forming a double seam. The author outlines six rules for producing air-tight seams and describes the operation of the modern automatic "air tester" or compressed air can testing machine. JN (12h)

Drawing One-Piece Hollow-Walled Shells. J. E. Fenno. *Machinery,* Vol. 38, Oct. 1931, pages 88-90.

Detailed description of specially designed dies used to make conduit units which were formerly made from bar stock in a screw machine. Present method reduces the cost of manufacture 60% and 2 sets of press tools produce 2700 parts/hr. RHP (12h)

The Construction and Uses of Typical Dies. Part VI. Edward Heller. *Metal Stampings,* Vol. 4, June 1931, pages 503-504, 512.

A discussion of press brake bending dies and the production of 90° bends with various types of "V" dies. The combination of several "V" dies in one die block is shown. JN (12h)

Cold Working (12j)

Cold Metal Working. E. P. Van Leuven. McGraw-Hill Book Company, New York, 1931. Cloth, 6¼ x 9¼ inches, 275 pages. Price $2.25.

A text book for manual training schools, with illustrated descriptions of such things as how to use a monkey wrench and how to make an ash tray. Good for its purpose, but not of metallurgical interest. H. W. Gillett (12j)-B-

The Influence of Cold Stretching on the Magnetic Susceptibility of Metals. (Zur Frage des Einflusses der Kaltreckung auf die magnetische Suszeptibilität der Metalle.) A. Kussmann & H. J. Seemann. *Naturwissenschaften,* Vol. 19, Apr. 3, 1931, page 309.

Experiments showed that the susceptibility of paramagnetic Al and of Ni-Cu-Zn alloys do not change on stretching. WHB (12j)

Machining Parts for Continental Aircraft Engines. Burnham Finney. *Iron Age,* Vol. 128, Dec. 3, 1931, pages 1418-1421.

Outlines steps in machining crankcase, crankshaft, connecting rods, pistons, cylinders and other parts of radial type aircraft engine at the plant of Continental Engine Co., Detroit, Mich. VSP (12j)

The Effect of Cold Work on the Physical Properties of Aluminum, with Special Reference to Its Specific Electrical Resistance. (English) G. Greenwood (University of Rochester). *Zeitschrift für Kristallographie,* Vol. 80, Nov. 1931, pages 481-494.

The specific electrical resistance of Al is increased by cold working and this increase can be removed again by annealing. It is removed completely by 10 min. annealing at 250° C. Annealing above this temperature causes another increase in the specific electric resistance owing probably to recrystallization of the metal accompanied by the production of cracks. Such an increase of other metals has been observed and explained by Credner (*Zeitschrift für physikalische Chemie,* Vol. 82, 1913, page 457). The breaking stress is also increased by cold working and decreased by annealing. Little decrease is obtained by annealing beyond 250° C. Cold working is done on the wire during such measurements and the breaking stresses of pieces of wire, which have once been broken, were found to have been increased except for those wires which have been annealed at temperatures above 250° C. Credner's hypothesis of crack production will also account for this. Cold drawn Al wire is known to possess a fibrous texture, in which the crystallites are arranged so that the (111) direction is parallel to the fibre axis. X-ray photographs showed that this texture is more marked, the more cold working there has been done on the wire. Recrystallization is seen to set in when the wires are annealed at about 250° C., although it is far from complete in wires annealed at 350° C. The fibrous texture is very persistent and can be detected in wires annealed at 350° C. Further cold working of these recrystallized wires breaks up the large grains and also produces a new fibrous texture, in which the particles are arranged with the (100) direction parallel to the fibre axis. The production of this new texture is more marked, the higher the temperature of annealing. X-ray photographs confirm previous observations that cold working of Al does not cause blurring of the doublets. Lattice distortions of the v.Arkel type (*Naturwissenschaften,* Vol. 13, 1925, page 662) are therefore not present, although distortions of the type discussed by Dehlinger (*Ahnalen der Physik,* Vol. 2, 1929, page 749) which might even approximate to the vitreous phase of Beilby, may occur. (*Proceedings Royal Society,* Vol. 72, 1903, pages 218, 226; Vol. 76, 1905, page 462; Vol. 79, 1907, page 463.) EF (12j)

Polishing & Grinding (12l)

Grinding Motor Parts to Close Tolerance, Cadillac Motor Car Co. *Abrasive Industry,* Vol. 12, Nov. 1931, pages 11-14.

The shafts are turned in special camshaft lathes. The set-up for grinding the cams is a special unit developed for the work. It is fitted with an alumina wheel 18 in. in diameter, with a ¾-in. face, 50 grit, shellac bond. WAT (12l)

Steel Mill Roll Finishing. H. J. Wills. *Abrasive Industry,* Vol. 12, Nov. 1931, pages 15-16.

Various phases of steel mill roll grinding are discussed in detail. WAT (12l)

Use of Diamonds. *Abrasive Industry,* Vol. 13, Jan. 1932, page 28.

An even, steady pressure will not injure a diamond, but sharp blows will split it and overheating will wear it rapidly. Reset diamonds will cut just as well as new ones. WAT (12l)

Grinding Methods for Motor Rims. *Abrasive Industry,* Vol. 13, Jan. 1932, pages 9-11.

Rubber-bonded wheels 14-18" in diameter are used at peripheral speed of 8000 ft./min. for grinding the outside of the welds. Somewhat smaller sizes are used for the inside work on the rims. WAT (12l)

CHEMICAL ANALYSIS (14)

The Use of Bromate in Volumetric Analysis. VI. The Determination of Iron Using Basic Mercuric Bromate. G. Frederick Smith & H. H. Bliss. *Journal American Chemical Society,* Vol. 53, Dec. 1931, pages 4291-4297.

Advantages of the bromate determination of iron as described in this paper make its use favorable as compared with the use of permanganate, dichromate or iodate and particular emphasis is directed to the fact that many organic materials, if present, do not interfere with the application of the method. MEH (14)

The Determination of Manganese in Cobalt Steel. (Die Bestimmung des Mangans in Kobaltstählen.) Fritz Spindeck. *Chemiker Zeitung,* Vol. 55, Sept. 19, 1931, page 723.

Dissolve 1-2 g. sample in HCl (sp. gr. 1.12) and oxidize with concentrated HNO_3. Evaporate to dryness, dissolve in HCl, dilute, boil and cool. Transfer to a 1 liter volumetric flask and precipitate Fe with ZnO. Dilute to the mark, mix and filter an aliquot part equal to 0.2 g. sample. Add 20 cc. HCl and Br water and allow to stand for 10 mins. Add an excess of NH_4OH, boil, filter and wash with hot H_2O. Dissolve the precipitate in $(NH_4)_2Fe(SO_4)_2 + H_2SO_4$, oxidize with HNO_3 and boil. Finish in the usual way by oxidizing with $AgNO_3$ and NH_4SO_4 and titrating with Na_3AsO_3. CEM (14)

Utilization of Micro-Analysis for the Investigation of Noble Metal Alloys. (Ueber Anwendung der Mikroanalyse zur Untersuchung von Edelmetallegierungen.) R. Strebinger. *Die Metallbörse,* Vol. 21, June 27, 1931, page 1206.

Recent use of Ni, Pd, Ag, Zn, Mn, etc., rendered the traditional streak method rather difficult. Strebinger and Holzer developed the following method: the scratch of the noble metal alloy is made on a carrier (glass) provided with a cavity and a rough surface by a sand blast. The base metals are extracted by dissolving media. The subsequent gravimetric, colorimetric and spectroscopic operations are outlined with reference to the different alloys. A paper before the 36th general meeting of the Deutsche Bunsengesellschaft für angewandte physikalische Chemie, Vienna, 1931. EF (14)

Manganese in Manganese Steel. J. H. Spillane. *Chemist-Analyst,* Vol. 20, Nov. 1931, page 10.

Dissolve 0.5 g. sample in 25 cc. 3:4 HNO_3 and boil till nitrous fumes are expelled. Add 50 to 60 cc. concentrated HNO_3 and 1-2 g. $KClO_3$; boil to half volume. Cool, add 200 cc. H_2O and a measured amount of H_2O_2 in excess. Titrate excess H_2O_2 with $KMnO_4$ and determine blank between H_2O_2 and $KMnO_4$. H_2O_2 solution consists of a 1 lb. bottle of H_2O_2, 275 cc. concentrated H_2SO_4 and 6000 cc. H_2O. CEM (14)

Determination of Tin in Irons and Steels. J. A. Scherrer. *Bureau of Standards Journal of Research,* Vol. 8, Feb. 1932, *Research Paper* 415, pages 309-320.

Apparently Sn is invariably a constituent of irons and steels, usually in amounts ranging from a few thousandths to a few hundredths of 1 per cent. The accurate determination of such small amounts of Sn is difficult, and methods that have previously been recommended are unsatisfactory. Practically all of these methods are based on the reduction of Sn to the divalent state, followed by oxidation to the quadrivalent state by means of a standard solution of iodine. The chief sources of errors in such methods lie in failure to remove other compounds that are reduced and oxidized, or in incomplete recovery of Sn when separations are attempted. As a result of the present study, a method has been developed in which Sn is separated from interfering elements, such as Cr, V, and W, by precipitation as sulphide in dilute HNO_3 solution, and then separated from elements, such as Cu and Mo, by precipitation with ammonium hydroxide. These treatments remove the elements that interfere, and the Sn is then reduced in a sulphuric-hydrochloric acid solution containing granulated lead, and afterwards oxidized as usual by means of a standard solution of iodine. With proper precautions, results that are accurate to 0.001% can be easily obtained. WAT (14)

The Determination of Lead in Slag. (Ueber Bleibestimmung in Schlacken.) Wilhelm Witter. *Chemiker Zeitung,* Vol. 55, July 18, 1931, page 550.

To separate from SiO_2, $BaSO_4$ and $CaSO_4$, use a 1 g. sample, add 50 cc. H_2O, boil, add 2 g. NH_4F and, with shaking, 20 cc. HCl (sp. gr. 1.1) and warm. Stir the residue. After 20 min., everything but the sulphides should be in solution. Add 5 cc. $KMnO_4$, boil for 10 mins., dilute to 250 cc. and pass in H_2S. Filter, wash with H_2O, Na_2S solution and H_2O. Dissolve the precipitate in HNO_3, add 10 cc. concentrated H_2SO_4 and evaporate to fumes. Dilute to 200 cc., boil, cool and filter. Dry and weigh $PbSO_4$ or dissolve in ammonium acetate and titrate with Mo solution. CEM (14)

Potentiometric Titrations in Zinc Chloride Solutions. (Potentiometrischen Titrierungen in Zinkchloridlösungen.) Milda Prytz. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 200, Sept. 12, 1931, pages 133-143.

Potentiometric titrations of metal salts can not very well be made with a hydrogen electrode; the author used with good results a Pt-plated Pt electrode which had to be freshly plated after each test. Method and test results of the molecular Zn concentration are described. Ha (14)

The Determination of Potassium with Perrhenium Acid. (Die Bestimmung von Kalium mittels Perrheniumsäure.) H. Tollert. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 204, Feb. 9, 1932, pages 140-142.

The great suitability and accuracy of this method is pointed out and analyses reproduced. 6 references. Ha (14)

The Sampling of White Metal Scrap with Particular Reference to American Methods. (Die Bemusterung von Altweissmetallen und Rückständen unter besonderer Berücksichtigung amerikanischer Usancen.) R. Thews. *Die Metallbörse,* Vol. 21, Apr. 11, 1931, pages 675-676; Apr. 18, 1931, pages 723-724; Apr. 25, 1931, pages 771-772.

Fifteen chief groups of tin bearing scraps, chips, residues, slags, etc. are specified, which are correspondingly subdivided as to the main element or to the origin. The author in particular refers to methods of specification familiar to the American scrap market. WHB+EF (14)

Chemical Analysis of Calcium in the Surface Layer of Eroded Gun Bores. N. Seliakoff & E. F. Alexeeff. *U. S. S. R. Scientific-Technical Department,* No. 401, *Transactions State Physical-Technical Laboratory,* No. 14, Moscow, 1930.

The presence of calcium in the surface layer of eroded gun bores was investigated by means of the M. Siegbahn's spectroscopic X-ray apparatus. Specimens 10 x 3 x 3 mm. taken from the surface layer of the eroded gun bores were analyzed and the presence of Ca was detected. When this was discovered, the microchemical and microanalytical analysis were made. The surface of the eroded gun was treated with the hydrochloric acid. A small quantity of solution was placed on the watch glass and a drop of concentrated sulphuric acid was added. The characteristic crystals of gypsum were observed under the microscope at 100 and 200 magnification. A sample taken from the eroded surface layer of bore near the breech and containing Cu was analyzed. Cu was dissolved in the nitric acid and it was determined that 1 mg. of Ca was present in 18 mg. of Cu; i.e., the content of Ca was about 5% of the Cu content. AIK (14)

Analysis of Sheet Zinc. Alfred Kundert. *Chemist Analyst,* Vol. 21, Mar. 1932, pages 10-14.

To a 30 g. sample add 25 cc. H_2O and 100 cc. concentrated HCl in 25 cc. portions. When action ceases add a few drops HNO_3 and heat until solution is complete. Separate Fe as basic acetate and titrate with $KMnO_4$. Add 15 cc. HCl to the filtrate, heat to boiling and add .5 g. powdered c.p. Al, stirring occasionally for 15 min. Filter rapidly and wash. Discard the filtrate containing the Zn. Wash the reduced metals from the filter into a beaker and dissolve in 3 cc. HNO_3 and a little HCl. Separate Pb as $PbSO_4$. Neutralize filtrate with NH_4OH and add 10 cc. 40% H_2SO_4 to every 100 cc. Precipitate Cu and Cd with H_2S and filter. Dissolve CdS in 1:3 HCl. Dissolve CuS in HCl + Br and determine colorimetrically. Add H_2SO_4 to Cd solution, evaporate to fumes, reprecipitate with H_2S, filter and dissolve in HCl, and titrate Cd with $K_4Fe(CN)_6$. In titrating Zn with diphenyl benzidine as an internal indicator the best Zn concentration is that which requires 10 cc. N/10 $K_4Fe(CN)_6$ for 100 cc. solution. The purple endpoint develops very slowly and requires shaking. CEM (14)

Experiences with the Magnetic Rapid Determination Method for Carbon by Malmberg's Karbometer. (Erfahrungen mit der magnetischen Schnellbestimmung des Kohlenstoffs mit dem Karbometer von Malmberg.) Heinz Kornfeld. *Archiv für Eisenhüttenwesen,* Vol. 5, Mar. 1932, pages 477-481.

Report 87 of Chemical Committee Verein deutscher Eisenhüttenleute. Compiled from data of 7 German plant laboratories. With exception of a single case, deviations in results by Karbometer method for C- and alloy-steels are so large as compared with results on similar samples by analytical method, that the Karbometer does not appear suitable as a means for determining C, to replace analytical method for accurate results. Plants, that previously worked with many preliminary samples and obtained highly accurate work, are not able to work nearly as accurately with Karbometer in spite of considerably shortened time of determination. By means of large number of Karbometric determinations, a certain quantitative picture of the course of steel melting may be drawn, even with the large inconsistencies. This is essential for such plants that formerly worked without a large number of preliminary samples, or, in the case where due to peculiarities of melting process the C content changed so rapidly that laboratory samples could not keep up with C changes. As an example of this, customary or pig iron ore method was used, by which in contrast to the Siemens-Martin scrap method, the C content is reduced very quickly and non-uniformly. In such cases there are practical advantages for certainty of melting process by use of Karbometer. It is then only necessary to estimate individual analyses with sufficient care in the calculation. Tables are given showing exact % deviation in results for 722 C-steel samples and 442 alloy-steel samples. The % errors for C-steels run from 5.3 to 53.1%; for alloy steels, from 23.7 to 38.4%. DTR (14)

A Convenient Method for the Separation of Cadmium and Bismuth in Low Melting Alloys. W. H. Keefe & I. L. Newell. *Chemist-Analyst,* Vol. 21, Mar. 1932, pages 8-10.

Dissolve sample in HNO_3 and filter off metastannic acid. Determine Pb as $PbSO_4$. To the filtrate add H_2SO_4 to bring up to 25 cc. H_2SO_4 in 100 cc. solution. Pass in H_2S, filter off Bi_2S_3 and wash with 1:3 H_2SO_4 saturated with H_2S. Dissolve Bi_2S_3 in HNO_3 and determine as BiOCl. Neutralize the filtrate with NH_4OH until just faintly acid and pass in H_2S. Filter off CdS, dissolve in HCl and determine as $CdSO_4$. CEM (14)

The Quantitative Determination of Lanthanum by Precipitation as Oxalate or as Hydroxide and the Higher Oxide Formation of Lanthanum. I. M. Kolthoff & Ruth Elmquist. *Journal American Chemical Society,* Vol. 53, Apr. 1931, pages 1225-1232.

A precise volumetric procedure is described for a determination of lanthanum as lanthanum oxalate. The oxalate can be estimated gravimetrically as oxide if ignited to constant weight in an electric furnace at 800° to 900°C. and weighed in a well-closed weighing bottle. Lanthanum may be precipitated also as hydroxide by adding the lanthanum solution slowly to an excess of base. Lanthanum oxide heated for long periods of time at white heat in air can be transformed into higher oxides. MEH (14)

Determination of Cadmium in Cadmium Cyanide Plating Solution. G. B. Hills. *Chemist-Analyst,* Vol. 21, Mar. 1932, pages 7-8.

To a 10 cc. sample of solution add 15 cc. 1:1 H_2SO_4 and evaporate to fumes, adding a little HNO_3 to oxidize organic matter. Dilute to 200 cc., add exactly 7 cc. HNO_3 and plate out Cu. Evaporate solution to fumes, dilute and add 5 cc. HCl. Neutralize with NH_4OH and filter off Fe. Neutralize filtrate with HCl and add 3 cc. excess. Heat to boiling and add 15 g. sodium acetate. Divide solution into 2 equal parts. Titrate one part while hot with standard $K_4Fe(CN)_6$ using 10% uranium acetate as outside indicator. Add second portion and complete titration. CEM (14)

Analytical Chemistry of Rhenium. (Beiträge zur analytischen Chemie des Rheniums.) W. Geilmann & F. Weibke. *Zeitschrift anorganische und allgemeine Chemie*, Vol. 195, Jan. 17, 1931, pages 289-308.

A method for the determination of rhenium by precipitating it as sulphide from a solution by hydrogen sulphide and determining it quantitatively after its oxidation to perrhenate as nitronperrhenate. Ha (14)

Quantitative Analysis of Alloys by X-Ray Spectroscopy. C. E. Eddy & T. H. Laby. *Journal of Physical Chemistry*, Vol. 35, Dec. 1931, pages 3635-3638.

The authors criticize conclusions arrived at by Torrey and Barrett (*Journal Physical Chemistry*, Vol. 35, 1931, page 1156), regarding the X-ray emission method of quantitative analysis, which they feel would prejudice the use of this method. They state that their experience is that correct analyses can be made, using this method, provided certain conditions are fulfilled. They proceed to discuss the technique of Torrey and Barrett, pointing out where improvements could be made which would lead to satisfactory results being obtained. Some attention is paid to the results of previous workers in this field, which serve to support their contentions. OWE (14)

The Rapid Colorimetric Estimation of Potassium. Earle R. Caley. *Journal American Chemical Society*, Vol. 53, Feb. 1931, pages 539-545.

This paper describes a rapid colorimetric method for estimating potassium depending upon its precipitation as potassium picrate by an alcoholic solution of picric acid, with the subsequent solution of the separated precipitate in water, yielding a highly-colored solution suitable for colorimetric comparison. MEH (14)

Electrolytic Determination of Copper in Steel. Lawrence Anderson & Hubert Swett. *Chemist-Analyst*, Vol. 20, Mar. 1931, pages 7-8.

A 5 g. sample is dissolved in 100 cc. 1:12 H_2SO_4 with gentle heat. The residue of Cu and carbides is filtered off, washed and dissolved in 10 cc. HNO_3, Sp. Gr. 1.20, and 20 cc. H_2O. The solution is filtered, 10 cc. 1:3 H_2SO_4 added, and electrolyzed at 2-3 volts and 3.5 amps. for 25-30 minutes. The cathode with Cu deposit is washed, dried in alcohol and weighed. CEM (14)

A New Test for Tin. Irwin Stone. *Chemist-Analyst*, Vol. 20, Mar. 1931, pages 6-7.

To the neutral or acid solution an equal volume concentrated HCl and a small quantity of granulated Zn are added. The solution is stirred with a test tube containing cold H_2O. Then the moistened portion of the test tube is held in the colorless part of a Bunsen flame. If Sn is present a characteristic blue flame is seen along the walls of the test tube. The test is very sensitive, detecting the presence of .0025 mg./cc. CEM (14)

The Spectrographic Assay of Some Alloys of Lead. D. M. Smith. *Engineer*, Vol. 152, Oct. 2, 1931, page 359.

Abstract of a paper read before the Institute of Metals, Zurich, Switzerland, Sept. 15, 1931. See *Metals & Alloys*, Vol. 2, Nov. 1931, page 274. LFM (14)

The Determination of Sulphur in Foundry Cast Iron and Hematite (Die Bestimmung des Schwefels in Giessereiroheisen und Hämatit). G. Zenker. *Archiv für Eisenhüttenwesen*, Vol. 5, Aug. 1931, pages 101-103.

Report 84 of the Chemists' Committee of the Verein deutscher Eisenhüttenleute. After reviewing previous investigations of the chemists committee of the Verein deutscher Eisenhüttenleute on the determination of S in iron and steel and after giving a detailed description of the methods employed, the author summarizes the results of his investigations on the S determination of foundry pig iron and hematite carried on in collaboration with the laboratories of 6 German steel mills. It is shown that all the gravimetric and volumetric methods that are employed for the determination of S in pig iron give results that are in agreement. All the methods are suitable only when sufficient time is taken for the determination. If the time is limited, the O combustion method according to Holthaus is superior. GN (14)

Spectrum Analysis of Platinum Metals and Alloys (Spektralanalytische Untersuchungen an Platinmetallen und Legierungen). W. Gerlach & K. Ruthardt. *Siebert Festschrift*, 1931, pages 51-71.

Description of method with considerable detail on spectrum lines useful in determining presence of Cu, Fe, Ir, Ni, Os, Pd, Rh and Ru in Pt, and similar data for impurities in Ir and Rh. Quantitative methods of spectrum analysis for Ir and Rh in Pt are discussed and photometer curves of intensities shown. HWG (14)

An Oxidimetric Determination of Sodium. (Eine oxydimetrische Bestimmung des Natriums.) H. Gall & K. H. Heinig. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 202, Dec. 15, 1931, pages 154-160.

Description of the method by which it is possible to determine K as well as Na. Ha (14)

The Determination of Oxygen and Nitrogen in Iron and Steel by the Vacuum Fusion Method. (Ueber die Bestimmung von Sauerstoff und Stickstoff in Eisen und Stahl nach dem Vakuumschmelzverfahren.) W. Hessenbruch. *Stahl und Eisen*, Vol. 52, Jan. 28, 1932, page 87.

Discussion of Vacher & Jordan's vacuum fusion method for determining O and N in irons and steels, see *Bureau of Standards Journal of Research*, Vol. 7, 1931, page 375, and supplementary work of others. The writer confirms the work of Vacher and Jordan, using a modified gas analysis train. DTR (14)

The Present Ultimate Limit of Micro-Chemical Detection and Measurement. (Die heutigen Grenzen mikrochemischen Erkennens und Messens.) L. F. Hahn. *Die Metallbörse*, Vol. 21, Oct. 14, 1931, page 1854.

Appreciating the advances of X-ray spectroscopy and emission spectro-analysis on one hand, Hahn emphasizes the generally underestimated potentiality of micro-chemical methods on the other side and the speaker outlines the scope of utilization before the Verein Deutscher Chemiker, Vienna, 1931. EF (14)

Surface Effects on Assay Beads Caused by Metals of the Platinum Group. J. L. Byers (Michigan College of Mining and Technology). *American Institute Mining & Metallurgical Engineers, Preprint*, Feb. 1932, 17 pages.

Made Au beads weighing 500 mg. containing metals of the Pt group in concentrations of 0.02, 0.05, 0.1, 0.5, 1.0, 2.0, and 5.0%. The beads were made by wrapping the weighed quantities of Pt metals and Au in 20 g. of C. P. Pb foil and cupelling. Each bead was examined with a hand lens of 15X magnification, and the effects of the various metals on the appearance of the beads described. Micrographs (15X) of the beads are shown. The metals used were Ru, Rh, Pd, Os, Ir, Pt. A similar series of Ag-base beads was made and examined. X-ray diffraction patterns of a number of beads were also made. In both the Au and Ag beads the Pt metals in small quantities have a marked effect on the appearance of the beads, and it is suggested that all beads be examined in order that no source of Pt metals be overlooked. 3 references. JLG (14)

Application of X-Ray Spectroscopy for the Analysis of Ores and Metallurgical Products. (Über die Anwendung der Röntgenspektroskopie zur Analyse von Erzen und Hüttenprodukten.) W. Noddack. *Die Metallbörse*, Vol. 21, Oct. 17, 1931, page 1867.

Intensity of the spectral lines as a measure for the concentration. Accuracy, sensitivity, short time of measurement and small amount of sample necessary are stressed in this paper before the Verein deutscher Berg- und Hüttenleute, Berlin, 1931. EF (14)

The Sulphur and Soda Fusion. Archibald Craig. *Chemist-Analyst*, Vol. 21, Mar. 1932, pages 6-7.

Mix the sample of ore with 3 to 5 times its weight of a mixture of 10 parts S, 10 parts Na_2CO_3 and 14 parts K_2CO_3 and fuse in a covered Coors combustion capsule placed on a smaller crucible. For ores high in SiO_2 raise heat slowly at first and allow to cool as soon as the flux is completely liquid. After cooling leach the melt in cold water over night. Filter and wash and repeat the fusion of the insoluble residue. The method is useful in the analysis of mixed ores, for the determination of impurities in Sb and Sn ores and the determination of Sb and Pb in Cu ores. The fusion can also be used in bronze analysis for the purification of SnO_2 after HNO_3 treatment. CEM (14)

Diphenylamine as Indicator in the Determination of Iron in Silicates. C. J. Schollenberger. *Journal American Chemical Society*, Vol. 53, Jan. 1931, pages 88-89.

In presence of sufficient hydrofluoric acid in proportion to H_2SO_4 or HCl, diphenylamine is an excellent indicator for the dichromate titration of a solution containing ferrous iron. MEH (14)

Quantitative Spectrum Analyses for Tin in Lead, and Ti, Si and Fe in Commercially Pure Aluminum. (Beiträge zur quantitativen Emissions-Spektralanalyse unter besonderer Berücksichtigung der quantitativen Bestimmung von Zinn in Blei und der quantitativen Erfassung geringer Titan-Silicium- und Eisengehalte in Rein-Aluminium.) Josef Clermont (Technischen Hochschule zu Aachen). Dissertation, 1932. J. F. Bergmann, Munich, 1931. Paper, 6 x 9¼ inches, 50 pages. *Zeitschrift für analytische Chemie*, Vol. 86, No. 5/6, 1931, pages 191-216; No. 7/8, 1931, pages 271-288.

Used spark spectra with Zeiss spectrograph with 9x12 cm. plates. The internal standard method of estimation or a modification was used. In this method the intensity of lines of the low concentration element are matched with lines from the base element. The intensities of the lines were determined by inspection or by measuring the height of lines made with a rotating logarithmic sector. A table is given by which the amount of Sn in Pb can be determined if the relative intensities of lines are found. As Al did not have well suited low intensity lines by which Ti, Si or Fe lines could be compared, the lines of these impurities were compared with a Cu spectrum taken on the same plate. Again, tables are given from which the quantities of impurities can be determined after the necessary spectral lines have been studied. This method of analyzing Al was found to be reliable and satisfactory. It is much quicker than classical methods, and is also cheaper. 28 references. JLG (14)

Determination of Phosphorus in Alloy Steels Insoluble in Dilute HNO_3. A. B. Cargill. *Chemist-Analyst*, Vol. 21, Mar. 1932, page 5.

Dissolve 2 g. sample in 30 cc. HNO_3 and 20 cc. HCl and add 2 cc. HF. Evaporate to dryness and bake 15 min. Add 20 cc. concentrated HNO_3, and after the residue has dissolved almost neutralize with 1:1 NH_4OH. Precipitate P with ammonium molybdate and finish as usual. If V is present add 10 cc. N/10 $(NH_4)_2Fe(SO_4)_2$ before neutralizing. The method is especially useful for stainless steels. CEM (14)

An Outline of Microchemistry (1). Janet W. Brown. *Canadian Chemistry & Metallurgy*, Vol. 16, Jan. 1932, pages 6-8; Feb. 1932, pages 31-33.

A summary of general methods of microchemical analysis. A few "spot" tests and capillary methods are outlined. The value of microchemical methods as time and material savers is pointed out. The possibility of duplicating larger scale tests on very small quantities of material is pointed out. Thus melting point, boiling point, sublimation point, and chemical reactions and purifications may be adapted to micro-scale work. Adaptions to gravimetric analysis, volumetric analysis, micro-combustion and micro-Kjeldahl determinations are pointed out. A good English and German bibliography is appended. WHB (14)

The Determination of Strontium in the Mineral and Ore Analysis. (Ueber die Bestimmung des Strontiums in der Mineral-und Gesteinsanalyse.) W. Noll. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 199, July 21, 1931, pages 193-207.

The usual methods of determining Sr and its separation from Ba and Ca are discussed and their inaccuracies described. Separation with HNO_3 gives good results. Strontium (R = 1.27 A.U.) can be precipitated quantitatively with Pb (R = 1.32 A.U.) as chromate; a separation from Ca is not possible in this manner. Ha (14)


Join the Red Cross

Binding Materials in the Foundry. (Les Agglomerants en Fonderie.) E. RONCERAY. *Revue Fonderie Moderne*, Vol. 26, Jan. 25, 1932, pages 21-29.

The art of making cores, their mechanical requirements and the binding materials for the sand and the different types of cores are discussed. A good binding material must possess great binding power, good resistance to humidity and must make possible the easy removal of the core; in general, only oils possess all the necessary properties and test results of several kinds of oils with regard to drying temperature, flexibility in dry state and mechanical resistance are tabulated. Ha (22)

An Example of Application of Molding of Green Sand Cores. (Ein Anwendungsbeispiel fur Grünkernformerei.) A. ZANKL. *Die Giesserei*, Vol. 19, Feb. 5, 1932, pages 46-49.

The procedure of molding the cores of green sand is described; the sand used is the same as for molds without any binder. This method is recommended especially for castings with thin walls. Ha (22

Ingenious Device for Mounting Patterns on Plates. (Un Dispositif ingénieux de Montage des Modèles sur Plaques.) WISTERZEE. *Revue Fonderie Moderne*, Vol. 26, Apr. 25, 1932, pages 146-147.

Describes an arrangement which conveniently and easily can fasten patterns on plates or supports by means of clamps, angular holders, etc. Ha (22)

Pattern-Made Piece of an Air Compressor. (Mit Schablone hergestelltes Zwischenstück für Luftkompressor.) *Zeitschrift für gesamte Giessereipraxis*, Vol. 53, Mar. 20, 1932, pages 117-118.

Descriptive. GN (22)

Molding and Casting of Solid Pieces of Non-Ferrous Alloys. (Moulage et Coulee des Pieces massives en Alliages non-ferreux.) WISTERZEE. *Revue de Fonderie Moderne*, Vol. 26, Jan. 25, 1932, page 33.

In order to insure a perfectly sound casting of intricate shape, such as valves, angular pieces, etc. the metal is cast under increased pressure in the mold by elevating the gate up to about 2 times the height of the piece and connecting it by U-type bend to the underside of the mold. This pressure is said to suffice to make the metal fill all parts of the mold. Ha (22)

Contribution to the Study of Compacting Sand by Jolting. (Contribution a l'etude du tassement par secousses.) A. RODEHEUSER & R. WALLE. *La Fonte*, Jan. 1932, pages 99-104.

Condensed translation from a German article. Gives analysis of sands used, discusses tests in shop practice and laboratory experiments. See also "Contributions to the Knowledge of the Shaking Process," *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 23. FR (22)

The Making of Pattern and Mold for a Ship Propeller. (Schablonen und Form- Herstellung zu einem geteilten Schiffspropeller.) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 53, Feb. 21, 1932, pages 88-90; Mar. 6, 1932, pages 108-110.

A detailed illustrated description is given of the molding of a large ship propeller. GN (22)

Some Considerations in Gating and Pouring Castings. I, II. (Eenige beschouwingen over het maken van gietloopen en het gieten van gietstukken. I, II.) E. V. RONCERAY. *De Gieterij*, Vol. 6, Apr. 1932, pages 37-42; May 1932, pages 50-52.

Paper read before the American Foundrymen's Association. See *Metals & Alloys*, Vol. 2, Aug. 1931, page 150. MPW (22)

A New Cheap Molding Method. (Ein neues verbilligendes Formverfahren.) BECKER. *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 22, Feb. 7, 1932, page 78.

The new method which is covered by a German patent is described. The new molding method is assumed to more than double the molding capacity of a foundry. GN (22)

A Few Practical Hints in Making Wooden Patterns. (Einige beachtenswerte Winke bei der Anfertigung von Holzmodellen.) *Zeitschrift für die gesamte Giessereipraxis*, Vol. 53, Mar. 6, 1932, pages 111-112.

The article discusses a few points to be observed in making wooden patterns. GN (22)

How to Obtain Sound and Clean Castings. (Comment obtenir des Pièces de Fonderie saines et Propres.) *Revue de Fonderie Moderne*, Vol. 26, Feb. 10, 1932, pages 47-48.

Discusses briefly the advantage of the addition of certain fluxes to the molten metal, to obtain a sounder casting, economize in time and heating, fuel and labor, and also in the metal used due to lesser oxidation and savings in refractory materials. Ha (22)

Some Practical Data on Drying. (Quelques donnees pratiques sur l'etuvage.) *Revue de Metallurgie*, Vol. 28, May 1931, page 288.

See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 22. JDG (22)

A Study of the Pressure and the Volume of Air in Cupolas. (Etude de la pression et du volume d'air dans les cubilots.) CANAMERAS Y GONZALO. *Revue de Metallurgie*, Vol. 28, May 1931, pages 275-276.

See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 79. JDG (22)

Powder "Bruinella" for Elimination of Sulphur, Slag and Pipes. (Entschwefelungs- Entschlackungs- und Entlunkerungspulver "Bruinella.") R. BERGER. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 53, Apr. 17, 1932, pages 159-160.

The new powder to be added to cast iron for the elimination of sulphur, slag and pipes is claimed to have many advantages. It is added while the molten iron is tapped in the ladle and increases its temperature and fluidity. Experiments showed that it decreases the S content of the iron by about 40%, thus making the iron more machinable. Iron treated with the powder is denser and the powder reduces the tendency for the formation of pipes. GN (22)

The Sweeping of Oval Molds. (Le Troussage de Moules Ovales.) DELCROISETTE. *Revue Fonderie Moderne*, Vol. 26, Jan. 25, 1932, pages 30-32.

The molding of oval shapes by sweeping with an elliptic compass is described. Ha (22)

Molding Sand Testing as a Means of Its Control. (Application des essais de sable a la fonderie dans le but d'en assurer le controle.) H. W. DIETERT. *Revue de Metallurgie*, Vol. 28, May 1931, page 283.

See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 22. JDG (22)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

The abstracts in this section are prepared in coöperation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Load and Temperature Stresses in Circular Flat Plates. H. L. M'Broom & C. M. Moir. *Journal Royal Technical College* (Glasgow), Vol. 2, Jan. 1932, pages 665-679.

A paper in a previous issue (1930, page 230) of the above journal dealt, generally, with the close similarity of the equations for the direct stresses and the bending stresses in circular plates of uniform thickness. The parallelism of the stress equations was established for both loading and temperature conditions with the aim of providing 2 sets of general results in strict correspondence. The present work deals with several unusual flat plate problems, trying to simulate actual conditions as nearly as possible. The research is almost entirely mathematical. It considers (1) a plate with uniform lateral pressure and a temperature drop through the metal varying with radius; (2) a plate with a central zone of uniform pressure and temperature drop, and an outer zone with radial variation of both; (3) a plate loaded laterally with uniform pressure with either free or fixed periphery and carried on a ring support placed for minimum stresses; and (4) a rotating disc with lateral pressure and rotational stresses and with transverse and radial heat flows. WAT (29)

Temperature Stresses in Non-Circular Drums. H. L. M'Broom & C. M. Moir. *Journal Royal Technical College* (Glasgow), Vol. 2, Jan. 1932, pages 657-665.

Presents a short theoretical investigation of the stresses in the walls of non-circular thin drums due to variations of temperature throughout the material, and constitutes an extension of work previously (1931, Vol. 2, page 427) published in this journal. Allowance is made for varying flexural rigidly in the walls. A brief consideration of certain special cases which include most practical types is appended, together with examples demonstrating the application of the results to numerical cases. WAT (29)

High Temperature Strength of Alloy and Plain Carbon Cast Steel. (Warmfestigkeit von legiertem und unlegiertem Stahlguss.) Karl Heinz Müller & Eugen Piwowarsky. *Archiv für Eisenhüttenwesen*, Vol. 5, Mar. 1932, pages 483-485.

The notch toughness, hardness, tensile strength of 8 steels were studied in the temperature range of 0° to 500° C. The composition and annealing temperature of the 8 samples are given in the following table:

Steel No.	Chemical Composition, Percent[1] C	Si	Mn	P	Misc.	Annealing Temp. ° C.[2]
1329	0.12	0.70	0.72	0.036	......	930
715	0.32	0.38	0.70	0.041	....	850
57	0.36	0.58	0.83	0.040	....	850
101	0.18	0.47	0.87	0.042	2.21 Cr	880
112	0.69	0.42	0.89	0.040	2.16 Cr, 1.04 W	800
182	0.36	0.42	1.96	0.046	......	850
1339	0.31	0.43	0.64	....	1.24 Cr, 2.98 Ni	930
1682	0.40	0.47	0.72	0.017	2.36 Cr, 0.40 Mo, 0.12 V.	930[3]

[1]S present in traces only.
[2]Cooling in furnace.
[3]Tempered in air, annealed for 2 hours at 600° C.

The tensile strength, hardness and endurance strength increased appreciably with increasing C content. Addition of Mn increased these properties slightly, while Cr, especially in combination with W, or still more noticeably with Ni, produced appreciable increases in these properties. The reverse of this was true with notch toughness. DTR (29)

The 18-8 Iron-Chromium-Nickel Alloy with Particular Reference to Its Characteristics for Cracking Coil Service. H. D. Newell. *Preprint American Petroleum Institute*, Apr. 1931, 20 pages.

The characteristics of the 18-8 alloy are mainly dealt with. However, some comparisons of the creep strength of 18-8, 4-6% Cr and 2 C steels, 0.08 and 0.20% C, are made up to temperatures of 1350° F. Loads producing creep of 1% in 10,000 and 1% in 100,000 hours for these alloys are given. The precautions, limitations and disadvantages of the 18-8 alloy as applied to tube service are discussed in detail. Failure of alloy cracking tubes in service, however, have only been about 20 in number of all the tubes used. There is a considerable tonnage of the 4-6% Cr steel now being used by the oil industry and the straight 4-6% Cr type has been superseded by steels containing either 0.75-1.25% W or 0.40-0.65% Mo with the usual 4-6% Cr. Steels containing 4-6% Cr without any alloying additions have no advantage over C steel, insofar as creep strength is concerned. In the 18-8 alloy, while the higher C content will stabilize the austenite, it increases the chance of chromium carbide being precipitated to the grain boundaries, causing local impoverishment in Cr content, which means less corrosion resistance and more tendency for creep at high temperatures. The attainment of this knowledge is said to have been the main accomplishment of the past year regarding the 18-8 alloy. Apparently, plain C steel or the 4-6% Cr steel tube will be the most used for the present. The 18-8 alloy finds a useful field where higher temperatures and pressures prevail, together with severe corrosive conditions. WAT (29)

Tensile Testing of Bars and Wires at Low Temperatures. (Festigkeitsprüfungen an Stangen und Drähten bei tiefen Temperaturen.) F. Pester. *Zeitschrift für Metallkunde*, Vol. 24, May 1932, pages 115-119.

The tensile properties of Cu, bronze, Al, "Aldrey," and steel were studied at temperatures down to -60° C. A new testing machine for the determination of bending properties of wires at low temperatures is described. Curves are given showing the tensile properties of the alloys studied against temperature. In general the strength increases linearly with decreasing temperature for rolled or drawn materials. Elongation and reduction in area, however, do not show a uniform behavior. The bending capacity of Cu, bronze and Al increased with a temperature decrease to -60° C., while that of Aldrey did not change much. With steel the number of bends was a maximum at a temperature of -20° C. RFM (29)

The Wrought Austenitic Alloys (at High Temperatures). R. H. Aborn & Edgan C. Bain (United States Steel Corporation). *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E. Joint Research Committee*, 1931, pages 466-494.

For abstract of paper see *Metals & Alloys*, Vol. 2, Dec. 1931, page 324. In the discussion short-time tensile properties up to 1400° F. are reported for an austenitic Mn steel containing 0.47% C and 14.77% Mn. Its maximum tensile strength (130,000 lbs./in.^{2}) and proportional limit (35,000 lbs./in.^{2}) occur in the neighborhood of 200° F. Between 300° and 400° F. the elongation is more than 80%. There is a possibility that this type of steel could be machined and drilled if the temperature rise local to the tool could be maintained below the slight increase (200° F.) required to produce maximum toughening. The Republic Steel Company states that the widespread use of the 18-8 Cr-Ni type of steel, irrespective of its elevated temperature characteristics and the excellent resistance offered to corrosion, is probably due most of all to the ease with which it may be fabricated. L. Cameron & Son, Ltd., Sheffield, England, produces a steel containing 30% Ni, 11 Cr, 59 Fe and with as little C as possible. This alloy is readily workable either hot or cold. Short-time tensile properties presented show a strength of 52,000 lbs./in.^{2} and 20,000 lbs./in.^{2} and a yield point of 40,000 lbs./in.^{2} and 18,000 lbs./in.^{2} at 1290° and 1650° F. respectively. Increasing the Cr content to 19% results in a breaking strength of 47,000 lbs./in.^{2} at 1470° F. WAT (29)

The Strength at High Temperatures of Six Steels and Three Non-Ferrous Metals. *Department of Scientific & Industrial Research, Engineering Research, Special Report* No. 18, 44 pages. Price 9d.

The report describes the results of work, undertaken for the most part at the request of Synthetic Ammonia & Nitrates, Ltd., upon the examination of the short-time tensile and creep properties between 300° and 600° C. of 6 heat-treated steels, namely, 0.5% C steel, 3% Ni steel, Ni-Cr steel, Cr-V steel, stainless steel and staybrite, and also the properties between 150° and 500° C. of phosphor bronze, duralumin and 60:40 brass. Numerous charts are given, showing the variation with temperature of the ultimate stress, limit of proportionality, proof stresses and the stress-temperature relations for definite rates of creep extending to 10^{-5} in./in./day. Full details of the creep tests are given and the relative tensile and creep properties of the materials are discussed. The results obtained provide information permitting the estimation of suitable working stresses at different temperatures. (29)

Aluminum Brass, A New Valuable Alloy. (Aluminium-Messing, eine neue, wertvolle Legierung.) *Aluminum*, Vol. 14, Jan. 31, 1932, page 6.

The addition of even small amounts of Al (0.1%) prevents the evaporation of Zn entirely and increases the resistance to oxidation at high temperature. The material is especially useful for condenser tubes. A composition of 70% Cu, 30 Zn with 2% Al does not show any surface dezincification and oxidation at 775° C. Ha (29)

Torsion Testing Machine. (Machine d'essai a la torsion). R. Guillery. *Revue de Métallurgie*, Vol. 29, Jan. 1932, pages 52-64.

Torsion testing machine for wires is described. It is particularly suitable for the determination of the torsional strength at elevated temperatures. The torque is created by an oil damped spring. Means are provided for automatic registering of the torque, angle of torsion and number of revolutions. JDG (29)

Strength of Material and Future Development of the Steam Process. (Materialfestigkeit und weitere Entwicklung des Dampfprozesses.) K. Baumann. *Die Röhrenindustrie*, Vol. 24, Jan. 1, 1931, pages 3-5; Jan. 15, 1931, pages 16-18; Feb. 12, 1931, pages 51-53; Mar. 12, 1931, pages 63-65.

Tabulated data on 28 recently erected power plants, show the steady increase of pressure and steam temperature. The phenomenon of creep and the failure of Hooke's law at elevated temperatures is discussed. The minimum creep velocity of bolts is computed, the limit being 10^{-8} for 2 year's service. Fortunately no creep occurs in the longitudinal direction. The maximum creep velocity for different power plant parts is given as follows: steam pipes with welded joints and boiler tubes, 10^{-7}; superheater units, 10^{-6}-10^{-5}; turbine blades, 10^{-6}; screwed-on flanges of turbine housings, 10^{-8}. The properties of different materials at elevated temperatures are dealt with. The data are presented in 4 sets of curves, referring to a low carbon (0.15%) steel and to a Cr-Ni-Mo steel. The admissible stresses in steam pipes at high pressures and elevated temperatures, the stresses in tubes which transfer heat, the construction of tube flanges and their imperviousness and the behavior of flanges, when being put into operation are discussed. EF (29)

Apparatus for Long Period Temperature-Stress Tests on Metals. W. H. Hatfield, G. Stanfield, J. Woolman & N. B. McGregor. *Journal of Scientific Instruments*, Vol. 9, May 1932, pages 150-153.

An apparatus for high temperature mechanical testing suitable for accurate determination of creep and allied effects is described and illustrated, and the order of sensitivity indicated. The apparatus includes a sensitive optical extensometer reading to 0.3 millionths in./in. The test piece has an 8" gage length. A method of controlling the temperature of the specimen to ± ¼° C. in an electric resistance furnace makes use of a Pt resistance coil placed in the furnace, and which forms part of a Wheatstone bridge and through a control indicator and relay operates the adjustment of the furnace current to compensate for minor fluctuations from various causes. The loading device is a simple lever system equipped with knife edges, the load being applied by means of a screw placed under the 20:1 lever arm. WAT (29)

Investigation of the Hardness of Copper. I. E. Gorshkov & V. O. Gagen-Torn. *Metallurg* (Russia), Vol. 6, 1931, pages 173-176.

The change in the hardness of Cu at high temperatures and its relation to the O content were investigated. The hardness was found to increase proportionally with the O content within the limits of 0-0.28% O_2, corresponding to 0-2.5% Cu_2O. The temperature has a more marked effect than the O content on the hardness. (29)

The Cold Treatment of Certain Alloy Steels. G. V. Luerssen & O. V. Greene. *Transactions American Society for Steel Treating*, Vol. 19, Apr. 1932, pages 501-552.
See *Metals & Alloys*, Vol. 3, May 1932, page MA 150. WLC (29)

Symposium on Effect of Temperature on Metals. A.S.T.M. and A.S.M.E., Philadelphia and New York, 1932. Cloth, 6 x 9¼ inches, 829 pages. Price $6.00.
There is probably little realization of the tremendous amount of study of high temperature properties, which is going on at the present time. It requires a symposium such as the one sponsored by the A. S. T. M. and the A. S. M. E. to give us some realization of the scope of the work.
A review of such a symposium encounters the same difficulties as the review of an encyclopedia, and so we must mention every article in the symposium, lest we fail to convey the correct impression as to the multiplicity of subjects.
The authors and their subjects are as follows:
Kerr, on power plant industry; high temperature properties needed in immediate future; mostly tubes also weld metal. Allen, on Steam turbine materials; .01% per year creep allowable; much 12% Cr in use. Martin, on Steam piping; pipes and fittings—3% creep in 200,000 hours (22 years) allowable = .14% per year. Dixon, on Oil industry; creep stress; thermal conductivity, coefficient of expansion, corrosion; *indications of impending failure* (swelling). Rhodes, on Chemical industries; attack by H_2SO_4, HCl, alkali, tar distillates, H_2. Woodson, on Ferrous metal industries; resistors, japanning ovens, etc.; heat treating furnace parts; emphasize design of parts. Brown, on Non-ferrous industries; (roasting, smelting, refining). Roasting furnaces, in retorts; lead smelting; flue dust recovery. Boegehold and Johnson, on Automotive industry; auto and Diesel engines; pistons, valves, cylinders, bearings; aircraft likewise. Williams, on Ceramic industry; firing in kilns; firing refractories; china ware; vitreous enamel; glass industry. Bailey, Dickenson, Inglis and Pearson, on Trend in Great Britain; power plant, design, effect of creep on calculations; individual elements, Cr, Ni, Mo. Chevenard, on Properties at elevated temperatures; studies of metal deformation in regard to internal friction and viscous deformation.
Anderson, on Zinc alloys; hot mechanical properties of rolled, cast, extruded zinc and of zinc alloys with Cd, Cu, Sn, Al, Mg. Templin and Paul, on Aluminum and Magnesium; effect of alloying additions on strengths of Al and Mg. Darby, on Bearing metals; mechanical properties vs. temperature, and factors affecting usefulness and life. Price, on Cooper and its alloys; mechanical properties vs. temperatures; discussion by Bassett, also others. Spooner and Foley, on Creep of steels; compilation of data on ordinary and low alloy steels. Bull, on Cast steels; cast carbon and low alloy, above and below room temperature. Bolton and Bornstein, on Gray iron and Malleable iron; properties, structure and a discussion of "growth." Aborn and Bain, on Wrought austenitic alloys; mechanical, structural and corrosion characteristics of the wrought austenitic Cr-Ni steels. Pilling and Worthington, on Iron-chromium-nickel alloys; effect of variations in Ni and Cr on short time tests and long time tests for strength; also oxidation resistance. Crawford and Worthington, on Nickel alloys; high temperature mechanical properties of nickel and alloys of nickel. MacQuigg, on High chromium steels; mechanical and corrosion properties of chromium irons. Swanger, on Rare metals; silver, gold, tantalum, platinum and their groups. Harder, on Nitrided alloys; mechanical and other high-temperature properties of nitrided steels. Russell, on Low-temperatures; mechanical properties at medium low and very low temperatures. Mochel, on Thermal expansion; expansion values, their applications, and a very complete tabulation for a long list of materials. VanDusen, on Thermal conductivity; consideration of conditions in practice. Miss McCombs, Bibliography; 615 references, most of these in the last three years.
One of the first impressions on reading the book is that of being face to face with a new aspect of industry, one that is suddenly becoming of very great importance, and one in which the data are only beginning to be satisfactory.
Most of the authors published test data and gave the results of their own experience. A number of authors went further, and ascertained opinions throughout their branch of the industry. These opinions were obtained through questionnaires and are exceedingly valuable because of the different views expressed.
The value of the papers is also enhanced by the active discussion aroused, as for example in the case of Dixon on Oil Industry, Boegehold and Johnson on Automotive Industry, Price on Copper and Its Alloys, and Spooner and Foley on Creep of Steels.
Impressive also is Miss McCombs' list of 615 articles related to these subjects, a large proportion of these having appeared in the past few years.
With such a wealth of material it seems captious to criticize. From the practical point of view, however, it might be useful in a future symposium to give more data on actual service records. Some such service records are given, and these assuredly enhance the value of the book.
From the theoretical and design standpoint, it is unfortunate that we have resorted often to short time tests, when the information desired is in reality creep. Since the nature of the deformation in creep is quite different from deformation in rapid loading, it will be necessary to have actual creep data before much reliance can be placed on high temperature tests. We may as well face this condition, and accept the fact that we must carry out the tests over a long period of time.
While it is always possible to point out shortcomings, nevertheless the fact remains that the book under discussion is not only an outstanding contribution to the industry but is also indispensable to any one interested in the many phases of high temperature service.
M. A. Grossman (29) -B-

Metallurgical Investigations. *Iron & Coal Trades Review*, Vol. 124, Jan. 15, 1932, page 82.
Progress in research on creep phenomena in steel ingots and castings, cracking of boiler plates and inclusions in steel is briefly reviewed. Ha (29)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

The Parkerizing and Bonderizing Rust-Proofing Processes. *Engineering*, Vol. 132, Oct. 9, 1931, page 475.
Describes processes as carried out in the plant of The Pyrene Company, Ltd. at Brentford, Middlesex, England. Parkerizing is a process in which the surfaces of Fe and steel articles are converted by chemical means into phosphates which are insoluble in water and permanent in air. The solution used is made from "Parco" powder consisting mainly of Mn phosphate. The coating is less than 0.0002" thick. The Bonderizing process is similar, the solution being made from a powder consisting of Mn phosphate with a small amount of Cu salt. LFM (32)

Painting of Iron and Copper Sheets. (La Peinture sur Tole de Fer et sur Toles de Cuivre.) J. Meyral. *Cuivre et Laiton*, Vol. 5, Mar. 15, 1932, page 117.
The replacement of Fe sheets by Cu sheets is recommended as even a coat of paint is not an absolute protection from rust; the self-oxidizing of Cu on the other hand, is, with or without paint, absolute protection in Cu. Ha (32)

A Gas-Heated Japanning Oven. Applying the Finish to Electrical Equipment. *Gas World*, Industrial Gas Supplement, Vol. 96, Apr. 16, 1932, pages 15-16.
Abstracts an article by W. J. Miskella in "Industrial Gas," which describes the particulars of a gas-heated oven installation for japanning electrical equipment. MAB (32)

Aluminum Paint in Apparatus Construction. (Aluminiumanstriche im Apparatebau.) E. Becker. *Apparatebau*, Vol. 44, Apr. 1, 1932, pages 59-60.
Al paints for apparatus offer the following advantages: low weight, low capacity of heat radiation (it amounts at 40° C. only to about 30% of the internal heat of a black body and, therefore, makes it suitable as paint for boilers, furnaces, etc.) high capacity of reflection (about 60-75% of the impinging light is reflected) high resistivity to sulphur compounds, high resistivity to the effects of sun beams. Al paint is suitable for any material, such as steel, wood, cement, pasteboard, etc. The preparation of Al paints and the methods of painting are described. GN (32)

Gypsum as Insulator for Structural Steel. Henry Schwein. *Iron & Steel of Canada*, Vol. 15, Mar. 1932, page 25.
Deals with the subject of fire test on gypsum and gypsum products and the value of such products as protection for structural steel against high temperatures. Tests conducted by Hull and reported in Technical Paper No. 130 (Bureau of Standards) are dealt with in some detail, as are also the tests conducted in 1922 at Columbia University on floor construction composed of precast gypsum floor slabs supported on 10-inch, 15-pound channels. OWE (32)

Evaluation of Clear Nitrocellulose Metal Lacquers. G. C. Shakour & L. W. Munchmeyer (du Pont Co.). *Metals & Alloys*, Vol. 2, Dec. 1931, pages 331-336.
4 types of clear metal lacquers are briefly discussed, phenol condensation lacquers, lacquers from condensation products of polyhydric alcohols and polybasic acids, gum lacquers and nitrocellulose lacquers. Tests for various types of defects occurring in lacquered metal work are discussed. Corrosion tests of lacquer films, evaluation of such properties as adhesion, hardness and flexibility are described. Rating of lacquers is effected by dividing into 3 groups: (a) ratable properties, those of primary importance for the use in question, properly weighted from 0 to 100, (b) minimum requirements, of secondary importance but must be had to a certain degree; (c) economic factor. An example of the system of rating applied to 2 lacquers is shown. The essential detail in successful lacquering is cleanliness; short cuts around it are apt to be costly. WLC (32)

The Japanning of Steel. William J. Miskella. *Metals & Alloys*, Vol. 2, Dec. 1931, pages 318-323.
Japanning is a metal finishing process involving the application of a mineral substance similar to asphalt in proper thinner with a black pigment and finally drying by baking at a temperature in excess of 325° F. Such a coating is very long lived and resistant and is cheapest known surface protection. Modifications of japan by the addition of varnish gums, various applications, methods of application and baking are described. WLC (32)

What Should We Pay for Pipe Coating. H. B. Truett (Associated Oil Co.). *Oil & Gas Journal*, Vol. 30, June 4, 1931, pages T-45, T-47.
The economics of pipe line protection is discussed, an equation formulated and curves given. VVK (32)

Some Methods of Pipe Line Protection. *Petroleum World*, London, Vol. 28, May 1931, pages 164-170.
A coöperative group of coating manufacturers offer a few worthwhile suggestions. Proper application of pipe coatings is most important in obtaining lasting results. (32)

Report on the Results of Series Tests on White Paint Coatings with Reference to Atmospheric Stability and Protective Effect against Corrosion. II. Part: Results of 2½ and 3 Years Tests. (Bericht über die Ergebnisse einer Reihenuntersuchung von Weissfarben-Aussenanstrichen auf Wetterbeständigkeit und Rostschutzvermögen. XII. Teil: Ergebnisse nach 2½ und 3-jähriger Versuchsdauer.) E. Maass & R. Kempf. *Korrosion und Metallschutz*, Vol. 7, Dec. 1931, pages 293-302.
The second and third set of samples previously described were exposed to atmospheric destruction during a testing period extended to 2½ and 3 years respectively. Generally speaking, the coatings on Fe proved to be in a materially better condition than those on wood, while the paint coatings on the brick walls was about between the Fe and wood paint coatings. The testing results are presented in tabular form. The order of merit of the different paint coatings employed on Fe may be reproduced. The following groups could be clearly distinguished: (1) Pure lead chromate, lead white, sulpho-lead white, zinc white and compositions of lead chromate/lithopone and of zinc white/Titanox B. (2) Less favorable: pure titanium dioxide and mixtures of lead white/lithopone, sulfo-lead white/lithopone and partly zinc white/lithopone. (3) The lowest grade of paint coatings proved to be all the 3 kinds of pure lithopone and part of the mixtures zinc white/lithopone. EF (32)

Experimental Tests on Gold Ore from the Beardmore Gold Mines, Ltd., Port Arthur Area, Ontario. J. S. Godard. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 11-17.

Amalgamation of an ore essaying Au 0.93 oz. and Ag 0.13 oz./ton and Pb 0.03%, Zn 0.02%, Cu 0.02%, Fe 4.12%, As 1.02% and insoluble 79.51% gave recoveries of Au of 57% at 8% plus 48 mesh and 79% at 5% plus 100 mesh. Flotation with K Xanthate 0.15 lb. and pine oil 0.08 lb./ton after ball milling with coal tar creosote 0.20 lb./ton gave 83.6% of the ing gave 13.7% more in a product containing 2.46 oz., a total Au in a concentrate assaying 9.58 oz./ton; tabling the tailing gave 13.7% more in a product containing 2.46 oz., a total of 97.3% in a 6.79 oz. product. Cyanidation of minus 100 mesh ore gave recoveries of 97-98.5% with consumption of KCN of 0.53-0.61 lb. and CaO of 5.3-6.9 lb./ton. AHE (33)

The Development of Processes for the Treatment of Crude Ore, Accumulated Dumps of Tailing and Slime at Broken Hill, New South Wales. Members of the Broken Hill Branch of the Australasian Institute of Mining and Metallurgy. *Proceedings Australasian Institute of Mining and Metallurgy* No. 80, 1930, pages 379-444.

The development of the various processes which have led up to the metallurgical practice of the present day at Broken Hill are described. These include blast furnacing, gravity concentration, magnetic separation, the Potter process (use of hot acidulated flotation solutions), Delprat process (flotation using salt cake), the Cattermole process (aggregation in water suspension of selectively oiled particles), the DeBavay process (film flotation), the Elmore vacuum process (aeration during flotation by release of dissolved gases by vacuum), the minerals separation process (flotation-refinement of Cattermole process), Murex magnetic process (differential application of magnetic coating), Henderson's process for oxidized Pb, and differential flotation [Horwood, Lyster, Bradford ($NaCl-H_2SO_4$), Lowry and Greenway, Owen and Bradford ($CuSO_4$) processes.] Present practice with reagent consumption, assays and recoveries for each company is presented and trends in the field are discussed. AHE (33)

Laboratory Concentration of Wabana Iron Ore. T. W. Hardy & H. H. Bleakney. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 195-198.

Even after grinding to minus 200 mesh, 41.6% of the insoluble and 42.8% of the P are still locked with the Fe and are retained in concentration, making it too low grade for sponge Fe. AHE (33)

The Treatment of Gold Ores from the English Brook Area, Rice Lake District, Manitoba. C. S. Parsons. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 164-169.

A siliceous ore containing a small amount of sulphide and Au, principally native, from 3 claims, assaying 0.81 oz., 0.77 oz., and 0.28 oz. of Au/ton gave recoveries of 71.6%, 92.2% and 67.9% by amalgamation. Cyanidation recovered 96.3%, 96.1% and 96.5% with normal reagent consumption. Flotation concentrates carried 70.7%, 85.1% and 71.8% of the Au. Amalgamation followed by flotation recovered 97.7%, 93.9% and 93.9%. Cyanidation of these concentrates gave 92% recovery with normal reagent consumption. AHE (33)

Eagle-Picher's Central Milling Project in the Tri-State District. R. J. Stroup. *Advance Paper, American Zinc Institute*, Apr. 1932, 11 pages.

The mill hopper at each change from one ore to the other is emptied and the concentrates produced from each tract are placed in separate bins. Automatic devices are arranged to keep the ores entirely separate and prevent filling the hoppers if they are not emptied. The advantages of a central milling plant over scattered units are better recovery due to better equipment and better supervision than at a large number of units, continuous operation and uniform feed; lower milling costs because of the large tonnage handled per man, lower power costs and lower costs of repairs and supplies; better control of grade of concentrate produced, elimination of duplication costs and reduction of overhead costs; and the investment is less than for individual units. Ha (33)

Experimental Tests on Gold Ore from the Arrowhead Consolidated Mines, Ltd., Joannes Township, Rouyn Area, Quebec. J. S. Godard. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 24-29.

A Au ore containing 1.21 oz./ton was floated and the tailing tabled, amalgamated and the tailing floated, amalgamated at various sizes, and cyanide at various sizes. At minus 100 mesh 98-99% can be recovered by cyanidation with consumption of KCN of 0.4-0.5 lb. and of CaO of 3.5-4.4 lb./ton. AHE (33)

Milling Methods and Costs at the Lead Concentrator of the Hecla Mining Co., Gem, Idaho. W. L. Zeigler. *United States Bureau of Mines, Information Circular* No. 6600, Apr. 1932, 16 pages.

A milling ore containing galena and marmatite averaged (1930) Pb 8.7%, Zn 1.2%, Fe 7.1%, insoluble 68.8%, and Ag 4.77 oz./ton is treated by combined gravity and flotation methods. The jig concentrate assayed Pb 52.02%, Zn 3.5%, and Ag 27.09 oz./ton and contained 65.8% of the Pb, 40.1% of the Zn and 62.5% of the Ag. Flotation of the reground jig middling (Pb 6.3%, Zn 3.0% and Ag 3.0 oz./ton), primary slimes and original minus 16 mesh ore using soda ash 0.1 lb., $ZnSO_4$ 0.3 lb., cresylic acid 0.1 lb., aerofloat (25%) 0.03 lb./ton gave a Pb concentrate assaying Pb 61.3%, Zn 5.0%, and Ag 34.6 oz./ton, containing 25.9% of the Pb, 16.6% of the Zn and 26.9% of the Ag. Flotation of the tailing with $CuSO_4$ 0.3 lb., aerofloat (25%) 0.05 lb. and Barrett No. 4 oil 0.05 lb./ton gave a Zn concentrate assaying Pb 9.3%, Zn 46.7% and Ag 10.1 oz./ton, containing 0.7% of the Pb, 27.7% of the Zn, and 1.2% of the Ag. The tailing contains only Pb 0.5%, Zn 0.3% and Ag 0.4 oz./ton. 1.2%, 5.6%, and 1.7% of the respective metals. The jig tailings, Pb 0.9%, Zn 0.1% and Ag 0.6 oz./ton, were floated to give a concentrate of Pb 46.0%, Zn 4.0% and Ag 31.4 oz./ton. 6.0% of the Pb, 4.0% of the Zn and 7.2% of the Ag. The tailing assays Pb 0.1%, Zn trace, and Ag 0.06 oz./ton, containing 0.6% of the Pb, 1.8% of the Zn and 0.8% of the Ag. AHE (33)

Milling Methods and Costs at the Concentrator of the Miami Copper Co., Miami, Ariz. H. D. Hunt. *United States Bureau of Mines, Information Circular* No. 6573, Apr. 1932, 25 pages.

The Miami ore is of chalcocite and pyrite with subordinate amounts of oxidized Cu minerals disseminated mainly in a quartz-sericite schist. The chalcocite is secondary and occurs chiefly as films on the pyrite. The oxidized Cu minerals are silicate (predominately), carbonates and oxides. Sulphides are removed from a mill feed assaying (average for 1930) Cu 0.716%, oxide Cu 0.112%, sulphide Cu 0.604% by bulk flotation by over oiling and adding flotation reagents in stages. The resulting coarse concentrate is reground and reconcentrated. The low-grade Cu concentrate from the cleaner cell of the primary circuit is reground and selectively floated to give a concentrate, assaying about Cu 40%, Fe 20% and insoluble 3%. The consumption of flotation reagents was (1930) pine oil 0.1619 lb., K xanthate 0.1481 lb., Na xanthate (experimental) 0.0024 lb., Na_2S (experimental) 0.0059 lb., reagent No. 323 (experimental) 0.0005 lb., lime 2.3426 lbs./ton of ore treated. Total costs were $0.29671/ton of ore. AHE (33c)

Milling Methods at the Balmat Mine of the St. Joseph Lead Co., Balmat, St. Lawrence County, New York. John B. Knaebel. *United States Bureau of Mines, Information Circular* No. 6574, Apr. 1932, 28 pages.

A sphalerite-pyrite-galena ore assaying Zn 12.29%, Pb 1.66% and Fe 12.93% was concentrated during 1930 by differential flotation to give 3 concentrates averaging as follows: Zn 55.88%, Pb 53.05%, and Fe 43.80%, respectively, with recovery of Zn 81.42%, Pb 59.01%, and Fe 45.08% (recoveries for first ½ of 1931 were 82.3%, 64.2%, and 66.2%, respectively). Tailings assayed Zn 1.90%, Pb 0.58%, and Fe 8.95%. Reagents in the Pb circuit are thiocarbanalid 0.1073 lb., cresylic acid 0.0307 lb., K xanthate 0.0239 lb., and NaCN 0.0954 lb.; in the Zn circuit $CuSO_4$ 2.2964 lbs., Na aerofloat 0.1280 lb., pine oil 0.1840 lb., lime 0.1840 lb., K xanthate 0.0208 lb.; in the pyrite circuit Barrett No. 4 0.0358 lb., K xanthate 0.1090 lb., $CuSO_4$ 0.1312 lb., Na_2S 0.1669 lb./ton of ore. AHE (33c)

The Flotation of Copper and Iron Pyrites in the Ore of the Aldermac Mine, Rouyn Area, Quebec. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 4-12.

A sulphide ore assaying Cu 1.98%, Zn 0.49%, Fe 40.5%, Au 0.09 oz. and Ag 1.18 oz./ton was floated to give a Cu concentrate, a Zn concentrate, a pyrite concentrate, and a pyrrhotite tailing. The use of soda ash-cyanide, lime-cyanide, or lime for conditioning agents gave Cu recoveries of 89.7%, 73.0% and 86.2%, respectively, in a product assaying Cu 14.75%, 18.91%, and 23.28%, respectively. For the most satisfactory test the following reagents were used: ball mill—lime 6.0 lbs.; Cu circuit—K xanthate 0.06 lb., pine oil 0.04 lb.; Zn circuit — K xanthate 0.05 lb., $CuSO_4$ 1.0 lb., pine oil 0.04 lb.; Fe circuit — amyl xanthate 0.30 lb., H_2SO_4 5.0 lbs., pine oil 0.06 lb./ton. Acidifying the pulp after Zn flotation yields the highest recoveries of pyrite (50-60%) in a product containing 48-50% S and 0.10-0.05% Zn. Dewatering the tailing from the Zn flotation prior to acidifying saves acid and does not affect pyrite recovery. AHE (33c)

Experimental Flotation Tests on Cobalt Ore from the Yorkshire Cobalt Mines, Ltd., Cobalt, Ont. J. S. Godard. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 160-163.

Cobaltite occurs in fine crystals in a diabase gangue assaying (2 lots) Co 2.19%, 2.70%; Ni 0.04%, 0.03%; As 2.85%, 3.55% and Ag 1.18 oz., 0.46 oz./ton. Flotation gave Co recoveries of 78% and 83%. The ore is slow to respond to flotation. Tabling of the tailings gives a low-grade product. AHE (33c)

Depression by Cyanide in Flotation Circuits. T. B. Brighton, G. Burgener & John Gross. *Engineering & Mining Journal*, Vol. 133, May 1932, pages 256-260.

The depressing effect of cyanide on sphalerite is less than on pyrite under the same conditions. The amount of cyanide required for complete depression of these minerals is inversely proportional to that abstracted by them. A study of the solubility of metallic xanthates indicates the formation of metallic xanthates on the mineral surface. Reagents reacting chemically with galena, such as dichromates, may also act as depressants. The xanthate coating may be due to the formation of a precipitate, a weak salt, or a complex ion. Some other effects of cyanides probably contributing to the depressing action on certain sulphides are: (1) with $ZnSO_4$, $Zn(CN)_2$ may be adsorbed, (2) complex cyanides and CN ions tend to change the polarity of the charge adsorbed on the sulphide surface, and (3) hydrolysis. CN affects the alkalinity of the pulp. WHB (33c)

Milling Methods and Costs at the Morning Concentrator of the Federal Mining and Smelting Co., Mullan, Idaho. M. P. Dalton. *United States Bureau of Mines, Information Circular* No. 6587, Apr. 1932, 11 pages.

The Morning mine ore consisting of an intimate mixture of Pb and Zn sulphides containing Ag, associated chiefly with siderite and quartz and assaying (typical) Pb 9.2%, Zn 6.70%, Fe 15.9%, Mn 1.9%, S 4.7%, CaO 1.2%, insoluble 39.3%, H_2O 3.5% and Ag 3.7 oz./ton is floated in 2 circuits to give a Pb and a Zn concentrate. Reagent consumption in the Pb circuit is $ZnSO_4$ 0.20 lb., Minerec A 0.11 lb., Barrett No. 4 0.05 lb., and Na_2CO_3 0.21 lb./ton of ore (cost $0.071) to give a concentrate of Pb 74.2%, Zn 5.8% and Ag 24.9 oz./ton for recoveries of Pb 91.0%, Zn 9.7% and Ag 81.1%. The Zn tailings assaying Pb 0.95%, Zn 6.50% and Ag 0.74 oz./ton are fed to the Zn circuit, treated with $CuSO_4$ 0.51 lb., Na xanthate 0.19 lb. and Barrett No. 4 oil 0.18 lb./ton of ore (cost $0.067), and yield a concentrate assaying Pb 2.8%, Zn 56.2% and Ag 4.8 oz./ton for recoveries of Pb 3.1%, Zn 85.7% and Ag 14.2%. Zn circuit tailings assay Pb 0.67%, Zn 0.38% and Ag 0.20 oz./ton. Pine oil (0.13 lb.) is added to the Pb concentrate to give a drier filter cake; lime (0.43 lb.) is used to assist in settling concentrates. Total costs for 1930 were $1.029/ton of ore milled. AHE (33c)

Principles of Flotation—An Experimental Study of the Effect of Xanthates on Contact Angles at Mineral Surfaces. IAN WILLIAM WARK & ALWYN BIRCHMORE COX. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 461, Feb. 1932, 48 pages.

Bibliography of 30 references. Refinements in the captive bubble method of Taggart, Taylor and Ince for measurements of contact angle between gas, liquid and mineral indicate errors in the pioneer work. Air does not displace water from the surfaces of many minerals, sulphides included, unless they be modified by some reagent. If a surface has been exposed to air before treatment with water, displacement of air by water may be slow. In a dilute solution of any xanthate (in some cases activating agents are necessary) contact of air with sulphide minerals is obtained. Gangue minerals, even in the presence of activators, do not respond to xanthates. Whenever contact is obtained, the angle is a constant for any particular xanthate, irrespective of the composition of the mineral; it increases with an increasing number of C atoms in the non-polar group of the xanthate. Evidence is presented that the adsorbed xanthate film is orientated with the ethyl group outward, being packed as closely as possible. The contact angle, therefore, is independent of the anchoring (polar) group. The effect of pH and cyanide on contact angle was investigated. JLG (33c)

Milling Methods and Costs at the Arthur and Magma Concentrators of the Utah Copper Co. H. S. MARTIN. *United States Bureau of Mines Information Circular* No. 6479, July 1931, 25 pages.

A monthly composite of mill heads contains (on basis of original ore) pyrite 2.60, chalcopyrite 1.71, chalcocite 0.21, covellite 0.17, bornite 0.11, total sulphide Cu 0.932, total non-sulphide Cu 0.052%. Average flotation reagent consumptions are, per ton of ore milled: CaO 3.79 (to give pH of 8.8-9.2), Na aerofloat 0.017, raw cresylic acid 0.18, and Aero brand cyanide 0.05 lb. Concentrates for April, 1930, assayed Cu 31.488, Fe 26.01, insoluble 5.29, S 35.20%, Au 0.242 and Ag 2.56 oz./ton. Recoveries were Cu 89.37, sulphide Cu 92.14, Au 72.98 and Ag 78.54%. Costs, which are detailed, total 30.217 cents/ton milled. AHE (33c)

Milling Methods and Costs at the Montana Mine Concentrator of the Eagle-Picher Lead Co., Ruby, Arizona. D. E. ANDRUS. *United States Bureau of Mines Information Circular* No. 6497, Sept. 1931, 14 pages.

Ore analyzing Pb 5.13, Zn 5.98, Cu 0.390%, Au 0.071 and Ag 8.17 oz./ton and consisting of galena, sphalerite and pyrite with subordinate amounts of chalcopyrite and tetrahedrite is concentrated by flotation. A Pb concentrate analyzing Pb 57.05, Zn 10.06, Cu 3.094%, Au 0.674 and Ag 74.02 oz./ton gives recoveries of Pb 92.59, Zn 14.02, Cu 65.33, Au 78.31 and Ag 75.49%. A Zn concentrate analyzing Zn 52.36, Pb 2.79, Cu 0.720%, Au 0.07 and Ag 12.40 oz./ton gives recoveries of Zn 68.29, Pb 4.23, Cu 14.41, Au 7.89 and Ag 11.92%. Tailings analyze Pb 0.19, Zn 1.26, Cu 0.095%, Au 0.011 and Ag 1.22 oz./ton, representing losses of Pb 3.16, Zn 17.68, Cu 20.24, Au 13.78 and Ag 12.58%. Reagents used, per ton of ore treated, are: CaO 0.995, Na_2CO_3 0.735, ethyl xanthate 0.057, thiocarbanalide 0.028, aerofloat 0.031, cresylic acid 0.150, pine oil 0.042, NaCN 0.219, $ZnSO_4$ 0.0640, Na_2SO_4 0.028, $CuSO_4$ 0.641 and Na silicate 0.258 lb. Costs from Oct. 1, 1929, to Apr. 1, 1930 were, in cents/ton: crushing and screening 32.12, grinding and classifying 25.20, flotation 59.81, filters 5.03, tailings disposal 6.23, water supply 7.55, miscellaneous 84.26 and total \$2.2020. AHE (33c)

Physical Chemistry of the Flotation Process. III. The Influence of Flotation Reagents on the Selective Wetting as the Physico-Chemical Characteristic of Their Collecting Power. M. E. LIPITZ & M. M. RIMSKAYA. *Tzvetnuie Metallui*, Aug. 1931, pages 990-1003.

The collecting ability of flotation reagents was determined by measuring the effect of their aqueous solutions of different concentrations on the wetting of paraffin (wetting isotherms). Measurements of the flotation activity of homologous series of alcohols, fatty acids, amines, phenols and xantates showed that the flotation activity increases with the lengthening of the hydrocarbon part of the molecules (with increasing assymmetry) parallel with the surface activity (i.e. in accordance with the rule of Traube), and with the decrease in solubility of the reagent in water. Only undissociated molecules actively influence the wetting of paraffin. Measurements of the flotation activity showed that xantates are analogous to other series of surface active substances. Measurements were made also of the flotation activity of soaps and oxidized paraffins. BND (33c)

Milling Methods and Costs of the Minas de Matahambre, S. A., Concentrator. A. R. KIRCHNER, J. V. GALLOWAY & W. P. SCHRODER. *United States Bureau of Mines Information Circular* No. 6544, 1931, 11 pages.

The ore consists of primary chalcopyrite associated with pyrite. Heads (1930) averaged 13% chalcopyrite, 7% pyrite, and 4.55% Cu; concentrates (flotation) 29.20% Cu and recovery 95.96%. Reagent consumption is potassium ethyl xanthate 0.409 lb., pine oil 0.272 lb., NaCN 0.031 lb., and lime (90-94% CaO) 0.206 lb./ton. Costs for 1930 were crushing and sorting 13.0 cents, concentrating 61.7 cents and total 74.7 cents per ton. AHE (33c)

The Concentration of a Lead-Zinc-Silver Ore from the Regal Silver Mines, Ltd., Albert Canyon, British Columbia. A. K. ANDERSON. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 112-115.

Five samples of sulphides of Pb, Zn and Fe in siliceous gangue assaying Pb 4.02-11.67%, Zn 1.20-3.17% and Ag 3.88-10.70 oz./ton gave recoveries of over 90% of the Ag and Pb by flotation using soda ash, cyanide and $ZnSO_4$ in the ball mills. Aerofloat No. 25 or K xanthate in the Pb cells and Aerofloat No. 25 + $CuSO_4$ or K xanthate + pine oil in the Zn cells. AHE (33c)

Flotation: Some Operating Details. KENELM E. ARMYTAGE. *Bulletin Institution of Mining & Metallurgy*, No. 329, Feb. 1932, 14 pages; discussion, No. 330, Mar. 1932, pages 15-24; No. 331, Apr. 1932, pages 27-28.

Methods of making an elutriation test of floatation pulp, the layout of a laboratory mill and classifier, an accurate dropper for laboratory flotation tests, a continuous feeder for testing plants, a laboratory cleaner cell, use of pH and a vacuum filter for preparing flotation solutions for pH determinations are described. AHE (33c)

Milling Methods and Costs at the Page Concentrator of the Federal Mining and Smelting Co., Kellogg, Idaho. G. S. PRICE. *United States Bureau of Mines, Information Circular* 6590, Apr. 1932, 6 pages.

Ore, consisting of an intimate mixture of Pb and Zn sulphides in a quartzite gangue, is concentrated by flotation. For the first 6 mos. of 1931, from a feed assaying Ag 4.32 oz./ton, Pb 10.95% and Zn 2.79%, a Pb concentrate assaying Ag 27.2 oz./ton, Pb 70.8% and Zn 6.9% with recoveries of Ag 88.9%, Pb 91.5% and Zn 35.1%, and a Zn concentrate assaying Ag 5.3 oz./ton, Pb 3.9% and Zn 51.3% with recoveries of Ag 3.7%, Pb 1.0% and Zn 55.0% were obtained at a cost of \$0.862 per ton of ore. Detailed costs for 1930 are given. Flotation reagents are Pb circuit: $ZnSO_4$ 0.88 lb., aerofloat (25%) 0.18 lb., and cresylic acid 0.07 lb.; Zn circuit: $CuSO_4$ 0.61 lb., Na xanthate 0.04 lb., Barrett No. 4 oil 0.06 lb., and pine oil 0.03 lb./ton of mill feed. AHE (33c)

Flotation Tests on Ore Sample from Sherritt-Gordon Mines, Ltd., Sherridon, Manitoba. G. B. WALKER. *Canada Department of Mines, Mines Branch, Report* No. 724, 1932, pages 18-24.

An ore assaying Cu 2.53% (chalcopyrite), Zn 4.98% (sphalerite), Fe 38.65%, insoluble 21.50%, Au 0.01 oz. and Ag 0.51 oz./ton gave Cu recoveries by flotation of 90-94% in a 12-15% rougher concentrate depending on the reagent used. The flotation of the sphalerite in a high-grade concentrate presents considerable difficulty due to the fast floating pyrrhotite. AHE (33c)

Recent Improvements in Metallurgical Practice in Western Australia. B. H. MOORE. *Chemical Engineering & Mining Review*, Vol. 24, May 5, 1932, pages 263-266.

The main requisites for flotation are grinding to the proper fineness, formation of bubble or froth and selective action of the bubble on sulphide mineral. Flotation of Wiluna and Kalgoorlie ores has been entirely successful. The all-flotation plant of the Wiluna Co. started operation in 1931, and Lake View and Star Ltd. have introduced flotation with satisfactory extraction and cost of treatment. Concentrates from these ores can be roasted successfully without the use of extraneous fuel, except for the initial heating. Roasting must be conducted at a low temperature until the first S of pyrite is oxidized, after which the temperature is raised without harmful effect. Cyanidation of the roasted concentrates presents no difficulties. Bromocyanidation will soon be employed at the new plant of the Boulder Perseverance Co. This purely chemical process requires wet grinding to 200-mesh, agitation for 2 hours with cyanide solution, addition of 1 lb. of cyanogen bromide/ton, further agitation for 1 hour, addition of sufficient CaO to insure precipitation and filtration. The cyanogen bromide should be added with the alkalinity not over 0.002% CaO. WHB (33c)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of METALS & ALLOYS, published monthly at Pittsburgh, Pa., for October, 1932. State of Pennsylvania, County of Allegheny, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Richard Rimbach, who, having been duly sworn according to law, deposes and says that he is the editor of the METALS & ALLOYS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Chemical Catalog Company, Inc., New York; Editor, Richard Rimbach, Pittsburgh; Managing Editor, Richard Rimbach, Pittsburgh; Business Manager, Philip H. Hubbard, New York.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) The Chemical Catalog Company, Inc., New York; R. W. Reinhold, New York; L. N. Thompson, New York; F. M. Turner, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stocks, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only.)

RICHARD RIMBACH, Editor.

Sworn to and subscribed before me this 23d day of September, 1932. [Seal] E. T. CHANCE, Notary Public.
(My commission expires March 7, 1933)

MANUFACTURERS' LITERATURE REVIEWS

500 **Blowers**—Bulletin 21-B14 of the Roots-Connersville-Wilbraham Co., Connersville, Ind., is devoted to their R-C-W blowers for pressure or suction service in connection with gas burners, crucible furnaces, annealing furnaces, annealing furnaces, smelting furnaces, drying ovens, etc. Other bulletins available are 22-B-10 for blowers used in ceramics, chemical processes, foundry cupolas, etc., and 23-B-10 for heavy duty blowers.

501 **Repairing for Profit**—A pamphlet with this title has been issued by the Linde Air Products Co., New York, N. Y. It contains two articles, one entitled "Oxy-Acetylene Welding in Automotive Repair" and the other, "Selling Auto Repairs Does Pay."

502 **Operating Recorder**—The Amthor Testing Instrument Co., Inc., 309 Johnson St., Brooklyn, N. Y., have prepared a leaflet describing their operation recorder which automatically records the entire operation of the machine on which it is installed.

503 **Lead Pipe**—A 23-page booklet prepared by the Lead Industries Association, 420 Lexington Ave., New York, N. Y., contains the new standards for lead pipe sizes and weights.

504 **Engineering Achievements, 1931**—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has reprinted from the *Electric Journal*, a group of articles which portray the accomplishments of engineering during 1931.

505 **Nickel Cast Iron Chart**—The International Nickel Company, 67 Wall St., New York, N. Y., has prepared a most convenient chart to assist engineers and foundrymen in the selection of suitable alloy compositions to meet special service requirements.

506 **Wire List**—The American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill., has issued a pocket-size booklet listing the products they make, from wire nails to elevator cables.

507 **Tool Steel Handbook**—The Columbia Tool Steel Co., Chicago Heights, Ill., has just sent out the fifth edition of their Tool Steel Handbook. It is a complete treatise on the use and handling of Columbia tool steels, together with new data and information supplementing previous editions.

508 **Plating Rolled Zinc and Zinc Die Castings**—A recent research bulletin published by the New Jersey Zinc Co., 160 Front St., New York, N. Y., has for its purpose the assembling, in as complete and concise a form as possible, the information necessary for the practical plating of rolled zinc and die cast zinc parts. The same company has prepared a wall chart giving the plating procedure step by step.

509 **Conveyor Belts**—The Wickwire Spencer Steel Co., 41 East 42nd St., New York, N. Y., has compiled a handbook devoted to metal conveyor belts. Each type is described and illustrated.

510 **Insulating Brick**—The Armstrong Cork & Insulation Co., Lancaster, Pa., has issued a 10-page booklet discussing their high temperature insulation for equipment in soaking pits, blast stoves, mill furnaces, etc.

511 **Case Hardening**—A 12-page leaflet sent out by the American Cyanamid & Chemical Corp., 535 Fifth Ave., New York, N. Y., describes the Aerocase process for case hardening steel in a liquid bath and gives applications of the process. Graphs illustrating the case structure are given.

512 **Electric Furnaces**—A leaflet prepared by the Falls Electric Furnace Corp., Buffalo, N. Y., shows examples of standard types of Falls electric furnaces of box and pot types.

513 **Heat Treatment**—The research staff of E. F. Houghton & Co., Philadelphia, Pa., has prepared a booklet entitled "Liquid Baths for the Heat Treatment of Steel." It presents the results of the study which the staff has devoted to this subject.

514 **X-Ray and the Airplane**—A leaflet sent out by the Kelley-Koett Mfg. Co., Covington, Ky., suggests a few of the many uses of X-ray equipment in the aircraft and allied industries.

515 **Alloy Metal**—The Jewell Steel & Malleable Co., Buffalo, N. Y., has sent out a leaflet showing the comparative physical properties of common castings and comparative machining tests of Jewell Alloy and other metals. Jewell Alloy is a heat-treated, white fracture, ductile iron of high yield and ultimate strength with an elongation of over 6%. It is said to be adaptable for all parts subjected to extreme heat, abrasion or corrosion.

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ALPHABETICAL INDEX TO ADVERTISERS

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516 **Staybolt Steel**—The Bethlehem Steel Co., Bethlehem, Pa., has issued a leaflet devoted to their Mayari nickel-chromium steels for railroad staybolts.

517 **Gas Furnaces**—A booklet issued by the American Gas Furnace Co., Elizabeth, N. J., describes their gas carburizing machines, gas heating machines for continuous heat treating and their gas oven furnaces. A leaflet published by the same company illustrates their equipment for steel treating on a production basis.

518 **Steel**—According to a circular sent out by the Union Drawn Steel Co., Massillon, Ohio, they are prepared to furnish cold drawn and turned and polished steel, turned and ground shafting, free cutting screw steel, rounds, squares, flats, hexagons and special shapes. A leaflet prepared by the same company describes their Field Metallurgical Service.

519 **Steel**—A booklet prepared by the Jones & Laughlin Steel Corp., Pittsburgh, Pa., contains a detailed description and illustration of each group of products shown by the company at the 14th National Metal Exposition.

520 **Die Castings**—The Aurora Metal Co., Aurora, Ill., has sent out their Bulletin No. 3 describing their aluminum bronze die castings, giving their composition and characteristics.

521 **Arc Welding Supplies**—Section No. 3304 published by the Lincoln Electric Co., Cleveland, Ohio, describes their line of welding supplies and gives prices for them.

522 **Soldering System**—A leaflet recently issued by the Selas Company, Philadelphia, Pa., describes the new design and construction of their soldering irons. A chart shows their application to different plant requirements. The same company has prepared leaflets devoted to their sieve-cap burners, Bunsen burners and spear-flame burner tips.

523 **Ultramicroscope**—A recent folder of the Bausch & Lomb Optical Co., Rochester, N. Y., illustrates their slit ultramicroscope, a new instrument to simplify the study of colloids.

524 **Bronze Welding Rod**—The Linde Air Products Co., New York, N. Y., has just sent out a 20-page booklet describing the physical and welding characteristics of their Oxweld No. 25 M. bronze welding rod. It includes recommendations on a new technique for bronze-welding and for the fusion welding of brasses and bronzes.

525 **Ferro Carbon-Titanium in Steel Making**—A most attractive 110-page book published by the Titanium Alloy Manufacturing Co., Niagara Falls, N. Y., is a complete discussion of the use of ferro carbon-titanium in steel for forgings, rail steel, steel for castings, etc. The book is well illustrated.

526 **Welding Electrodes**—Bulletin GEA-1546A of the General Electric Co., Schenectady, N. Y., is devoted to their welding electrodes and accessories. Electrodes for cast-iron welding, for automatic welding and for building up hard surfaces are illustrated. Bulletin GEA-1593 of the same company describes their electric equipment for mine hoists.

527 **Darkfield Microscopy**—Bulletin No. 2 of E. Leitz, Inc., New York, N. Y., describes a novel illumination device and a new series of objectives which are said to contribute very materially to the enhancement of microscopical diagnosis of metal structures. Bulletin No. 3 of the same company discusses their simplified model MM-2 micro-metallograph.

528 **Grinding Wheels**—A leaflet sent out by the Manhattan Rubber Mfg. Division, Passaic, N. J., describes their rubber-bonded abrasive wheels and gives a list showing their range of application.

529 **Industrial Gas Equipment**—A folder prepared by Charles A. Hones, Inc., Baldwin, N. Y., shows illustrations and prices of their various types of burners, automatic blast gas soldering and bench furnaces, and soft metal furnaces.

530 **Metal Degreasing**—Bulletin 18 of the Dow Chemical Company, Midland, Mich., discusses their solvents for use in metal cleaning and degreasing work. A sketch of a very generalized degreasing system is shown.

531 **The Titusville Forge Company**—A short description of their history, plant facilities, products and organization has been prepared by the Titusville Forge Co., Titusville, Pa.

532 **Welder's Manual**—The American Steel & Wire Co., Chicago, Ill., has published a 32-page welder's manual which illustrates the right welding wire for each job. Methods for gas and electric welding are discussed.

533 **Testing and Balancing Machines and Instruments**—Bulletin No. 9 of the Tinius Olsen Testing Machine Co., Philadelphia, Pa., is devoted to their pendulum dial load indicator lever weighing system and recorder.

CURRENT

METALLURGICAL ABSTRACTS

A digest of the important metallurgical developments of the world

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GENERAL (0)

The Place of Research in Industry. F. B. JEWETT. *Proceedings American Petroleum Institute,* Section III, Dec. 1931, pages 27-33; *Bell Telephone Laboratories,* Mar. 1932, 14 pages.

The activities of the industrial research group are motivated by the same considerations and governed by the same rules as those which apply to other parts of the organization. The group itself differs from the other groups primarily only in the character of training of its members. They are skilled in a knowledge of the facts and methods of science rather than in the facts and methods of efficient factory operation, finance, purchasing, salesmanship, etc. Generally it is not the largest unit of the industry but in many it is organized both within and without as a most substantial bulwark, not only in the direction of continued progress but against the vicissitudes of hard times. The research laboratory has proved itself time and again to be the saving factor in what might otherwise have been a very unpleasant situation. Of all the types of work which are to be found in industry there is no group in which it is so difficult to recruit rapidly a trained and efficiently working personnel as in the group which comprises the industrial research organization. The period of preliminary training is long and arduous and can be undertaken only by men of ability who have an inclination toward the rigors of a scientific life. The period of acquainting even trained men with the intricacies of the applications of science to any particular industry is likewise long. Further the period necessary to mold wholly efficient men into an efficient team is long. These men not only have to be of proper caliber and thoroughly trained in their own field, but they likewise have to be properly organized and their group properly coördinated with the other parts of the business. If their inclinations lead them to delve somewhat in scientific research fields foreign to the one they are cultivating, no obstacles should be placed in their way provided they still continue to be of value as cultivators of their own field. Where material of patentable novelty develops as a result of industrial research work, the strongest possible patents must be sought for and obtained if the work is to bear full fruit and the industry is to be protected in the time, knowledge, labor and expenditure which it has given. WAT (0)

Engineering Efforts of 1931 Directed Toward Economy in Operations. E. F. ROSS. *Steel,* Vol. 90, Jan. 4, 1932, pages 155, 159.

In spite of the continued depression, 1931 witnessed many new and remarkable accomplishments in the iron and steel industry. Blast furnace stacks were kept idle for short periods of time and restarted quickly without affecting pig iron quality. Mechanical control was introduced in open-hearth practice. Steel of the highest quality was produced at a lower cost. The forging industry developed a new method of pressure forging and the welding industry adopted codes governing fusion welding. Other developments include improvements in rolling mill equipment and control apparatus, improvements in heat treating methods, furnaces and refractories, improvements in machine tool design and in handling equipment, and the introduction of stainless steel rivets in fabrication. JN (0)

Proceedings of the American Society for Testing Materials. Part I. Committee Reports and Tentative Standards. Part II. Technical Papers. Vol. 34. American Society for Testing Materials, Philadelphia, 1931. Paper, 6 × 9 inches, 1119 pages, 1027 pages. Price $5.50 each.

About 330 pages of part 1 and 430 of part 2 refer to metallic materials. Besides the material included in these volumes, the Society has separate publications including 11 papers in a symposium on welding and 28 papers in a symposium on effect of temperature on properties of metals. The Society is active in research along metallurgical and metallurgical testing lines and its publications are always of extreme value to metallurgists. These volumes are no exception.

One of the highly important steps is the recommendation of the committee on mechanical testing that the term "yield strength" with a statement of the permanent set at that strength be used instead of "yield point." Thus the confusion caused by giving data for elastic limit, proportional limit, yield point, etc., in technical literature without adequate information as to the amount of plastic deformation taken as the criterion, may be avoided.

The metallurgical articles have been abstracted in *Metals & Alloys* from preprints on their appearance and have also been again listed to give the page reference in the final publication and include information brought out in discussion. H. W. Gillett (0) -B-

PROPERTIES OF METALS (1)

Mechanical Properties of Copper. (Proprietés mécaniques du cuivre.) Alexandre Krupkowski. *Revue de Métallurgie,* Vol. 28, Oct. 1931, pages 529-545; Nov. 1931, pages 598-609; Dec. 1931, pages 641-660; Vol. 29, Jan. 1932, pages 16-33; Feb. 1932, pages 74-92.

Formulas given by C. Bach and C. A. Bartella for elongation of usual tensile specimens per unit of length are only approximate. On the basis of theoretical consideration new formulas for Cu are proposed which, after experimental determination of the constants for annealed Cu become:

$$\text{Elongation } A = 0.409 + \frac{2.59}{3.1\,m + 1}$$

Distance between the punch marks expressed in original diameter of the test bar

$$m' = m\,(1.408 + \frac{2.59}{3.1\,m + 1})$$

$$\text{Reduction of area } \frac{d}{d_o} = \sqrt{\frac{1}{1 + \left[0.409 + \frac{2.59}{(3.1\,m + 1)^2}\right]}}$$

These formulas checked well with the results of tests made on annealed copper. A slight tendency towards giving lower values for diameters was observed. The amount of elongation for any given load lower than the one necessary for production of striction can be expressed by the formula $A_s = A + \frac{1}{2}(A\text{-}3a - 2)z$ where A is the total elongation obtainable on the material, z the percentage of deformation, a is the elongation before the beginning of striction.

Tensile strength is given as $R_z = R/(1 - z)$

Reduction of area is expressed as $\Theta_z = 1 - (1 - \Theta)/(1 - z)$

The work consumed in production of any elongation before the striction begins is

$$L_a = \frac{R.a.l_o.S_o}{10^3}\,(0.75 + 0.25\,\frac{E}{R})\ \text{kg./m.}$$

where a is elongation before the beginning of the striction, R. tensile strength in kg./mm.^{2}, l_o initial length, S_o initial cross-section in mm.^{2}, E elastic limit in kg./mm.^{2} Total work required for breaking a specimen can be expressed:

$$L_A = \frac{R \cdot A \cdot l_o \cdot S_o}{10^3}\,(\,1\text{-}0.25\,\frac{a}{A} + 0.25\,\frac{E}{R}.\frac{a}{A})\ \text{kg./m.}$$

where A is elongation after rupture. Figures calculated from these formulas agree with the results of tensile testing of drawn Cu wire. The possibility of latent heat of deformation was checked by proper measurement of the temperature of bars under test but it was found that almost all work required for fracturing is transformed into heat, proportionally raising the temperature of the bars. After a comprehensive survey of work already done on physical properties of Cu a set of experiments for the determination of physical properties of Cu at elevated temperatures is described. Provisions for testing in different atmospheres were made. Recrystallization of drawn commercial electrolytic Cu begins at 320° and is completed at 340°C. Testing annealed Cu in nitrogen showed that there is a hardening range for Cu between 150° and 500°C. as was reported by previous investigators. Within it tensile strength reaches its maximum; yield point remains practically constant; elongation drops slightly near the recrystallization point but recovers again and begins to decrease steadily only after 650°C. Starting with 567°C. all specimens were reduced to a point in breaking. In the malleable range from 500° to 800° C. the strains are relieved instantaneously. At 850° the cohesion between the grains is much reduced and the specimens break under a light load without any deformation. Testing in air and CO_2 showed that the physical properties were the same as when tested in neutral gases. Electrolytic Cu not remelted but annealed in CO_2 and pulled in CO_2 had elongation and reduction of area decreased to about 50% of the normal due to the lack of homogeneity of metal. Freed from hydrogen by heating for 10 hours in vacuum at 600° C. cathode Cu tested in hydrogen at room temperature did not exhibit any changes, but at high temperatures lost its ductility. Liquid air temperatures do not reduce the ductility of Cu. Brinell and Meyer formulas for hardness as applied to copper were checked. Meyer's relation $P = a.d^n$ is exact and his hardness represents the true hardness of the underlying metal while Brinell's does not. The detailed mathematical analysis and experimental study with cones of different angles showed that the difference between hardness numbers obtained with a cone and with balls depends on the difference in the processes of cold deformation depending on the shape of indenting tool and the charge. Meyer's formula shows therefore that for the metals which harden by straining under a charge the charge grows faster than the lateral surface, implying the relation between the charge and the amount of strain of the underlying metal. There is no need for introducing a coefficient of friction to explain the difference between cone and ball readings. The curve of hardness expressed as load per unit of lateral area varies as a function of the angle of the cone, passing through a maximum. Hardness expressed as load per unit of area of circular section increases with the diminution of the angle of the cone. The relation between the hardness figures obtained with a cone and with a ball is not constant depending both on the exponent (n) and the hardness of the metal. Taking readings of the impressions made on identical spots with the same instruments and after repeated annealing in neutral atmosphere the hardness of annealed Cu was found to be 13.5 Meyer units being independent of the shape of indenting tool and the load. Applying geometrical considerations a formula was derived for the rim formed around the impression obtained in hardness testing. It was checked experimentally on Cu having different degrees of strain. For dead soft Cu the edges are drawn down forming a funnel shaped impression. With about 4% strain the edge of impression exactly corresponds to the surface plane of the specimen. With higher strain a ridge above the surface of the specimen is formed. The coefficient of the rise of this ridge becomes constant above 17% strain. The shape of the ring formed by this ridge can be calculated by the formulas given, both for ball and cone impressions. The spread of the ring of deformation is a function of the elastic limit and the hardness corresponding to the average pressure. After critically reviewing previous work hardness determinations on strained cylinders and drawn wires were made. The hardness of Cu increases rapidly up to 30% of straining, and more slowly thereafter. Strained approximately 55%, hardness expressed as average load is given by a number independent of the shape of the tool and the load. The experimental procedure of the previous workers for determination of hardness of Cu at elevated temperatures is described pointing out the probable sources of error. Hardness at high and low temperatures was determined by impressions made with a stellite cone either immersed together with the specimen in properly controlled cooling bath or inserted in an electric furnace in a CO_2 atmosphere. Two series of annealed Cu and one of strained were tested. The curves of hardness change their slope at the temperature of recrystallization. Hardness of cold worked Cu drops rapidly until the recrystallization temperature remains constant for a while and then merges with the curve for annealed Cu. The latter is formed of 2 branches convex towards the axis of the temperature and uniting at the point of the recrystallization. The relation between Brinell hardness and tensile strength is very close for Cu. After a comprehensive review of opinions and experiments already done on the impact value of Cu a proper set up was devised. Notched bar specimens were broken on a Charpy machine. An accurate thermocouple was soldered inside of the notch. The supporting anvil was water cooled while the specimen was brought up to the desired temperature by means of a blow torch. The actual temperature at the moment of breaking was read directly. For low temperature testing the same arrangement was used only the specimens and the thermocouple were placed either into liquid air or a mixture of acetone with dry ice. For strained Cu the impact value decreases continuously to 500° C. with only a slight increase at the recrystallization temperature. Above 500° C. it increases rapidly reaching at 700° C. the value for annealed Cu. For Cu annealed in an inert gas (nitrogen) the maximum impact value is around the temperature of recrystallization (340° C.) after which it decreases. When the Cu is annealed in hydrogen its impact value remains practically constant between 50 and 500° C. 52 tables, 110 diagrams and microphotographs, 135 references. JDG (1)

Determination of Some Physical Properties of Magnesium Crystals. (Bestimmung einiger physikalischer Eigenschaften von Magnesiumkristallen.) E. Goens & E. Schmid. *Naturwissenschaften,* Vol. 19, May 1, 1931, pages 376-377.

The elastic and torsional moduli of differently oriented crystals of pure Mg were determined dynamically and from the results obtained the following elastic parameters have been calculated (in 10^{-13} cm.^{2}/dyne): $S_{11} = 22.3$; $S_{33} = 19.8$; $S_{44} = 59.5$; $S_{12} = -7.7$; $S_{13} = -4.5$. Addition of up to 2.3% Zn scarcely affects the elastic modulus. The thermal coefficient of expansion varies very little with change of orientation. The limiting value of the electrical resistance of the crystal is about $3.77 \times 10^{-6}\ \Omega$ cm. parallel to the hexagonal axis and $4.54 \times 10^{-6}\ \Omega$ cm. perpendicular to this axis. The dependence of the above properties on the orientation is compared with that previously found in the case of Zn and Cd. The differences cannot be explained on the deviation of the lattice from that of the most densely packed hexagonal lattice. WHB (1)

Emission from Aluminum and Its Alloys. (Emission von Aluminium und seinen Legierungen.) R. Hase. *Zeitschrift für technische Physik,* Vol. 13, No. 3, 1932, pages 145-155.

The radiation properties of Al are investigated as a function of the quality of the surface, of temperature, of wave length and of the angle of emission. The comparison with a black body shows in the range of 1 to 10 μ and at 400° C. a very small emission, particularly for rough surfaces, while a thick oxide layer gives approximately half the radiation of that of the black body in the same wave-range. Wien's law of dislocation takes the form of λ max. $\times$ T = 2700. Further the law of Stephan was confirmed whereby the emission increases with the fifth power of the absolute temperature; the formula for polished Al is $Q = 0.58 \times \left(\frac{T}{100}\right)^5 \frac{\text{kg. cal.}}{\text{m.}^2\ \text{hr.}}$ for vertical radiation. A great number of numerical values is given for powder and alloys of Al. 8 references. Ha (1)

On the Elastic Anisotropy of Iron. (Über die elastische Anisotropie des Eisens.) E. Goens & E. Schmid. *Die Naturwissenschaften,* Vol. 19, June 5, 1931, pages 520-524.

Sufficiently large Fe-single crystals (Armco) were prepared by recrystallization after critical stretching and the moduli of elasticity were determined dynamically by transverse vibration and the torsion moduli by a static method. The data obtained, show the remarkable anistropy of Fe crystals: $E_{(100)} = 13{,}500$ kg./mm.^{2}, $E_{(111)} = 29{,}000$ kg./mm.^{2}, $G_{(100)} = 11{,}800$ kg./mm.^{2}, $G_{(111)} = 6.100$ kg./mm.^{2} Measurements and interpretations of the anisotropy of cold-rolled electrolytic Fe are set forth. A minimum of the elasticity modulus was noticed at a 40°-45° angle with the direction of rolling. A deviation of 35% from the maximum perpendicular to the same direction was established. EF (1)

The Increase of Heat Radiation of Aluminum by Surface Treatment. (Ueber die Erhöhung der Wärmestrahlung des Aluminiums durch Oberflächenbehandlung.) G. Eckert. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk,* Vol. 4, Jan.-Feb. 1932, pages 31-32.

A few experiments are described which the author believes point to a remarkable possibility of an increase of the heat radiation from Al surfaces. An ordinary piece of Al pipe heated in the middle by a Bunsen flame of 1170° C. melted after 2¼ minutes but did not if the piece was coated with a very thin layer of sodium silicate. Ha (1)

PROPERTIES OF FERROUS ALLOYS (3)

Hollow Boring Tools. (Hohlbohrstähle.) R. Hohage. *Glückauf,* Vol. 67, May 23, 1931, pages 709-710.

The steel used for these tools must be of highest quality as they are subject to several vibration stresses. A few examples are shown where invisible defects on the outer and inner surface led to fracture. A refined electric-steel with 0.75% C which is used for these drills had a tensile strength of 73.6 kg./mm.², an elongation of 11.2%, a reduction of 40% and a notch toughness of 4.1 mkg./mm.². Ha (3)

Develops New Steel for Piercing Points and Plugs in Seamless Tube Making. *Steel,* Vol. 90, Jan. 18, 1932, page 25.

Crusco Steel is a new, superior alloy steel developed by the Crucible Steel Casting Co. for the manufacture of piercing points and rolling mill plugs. The alloying constituents are Cr, V, W, Co, and Ni. JN (3)

Steels for Rolling Mills and Grinding Mills. (Stähle für Walzwerke und Rollergänge.) *Tonindustriezeitung,* Vol. 56, Jan. 14, 1932, page 64.

With due consideration that steels for the above purposes must combine hardness and toughness, the following materials are considered as to their suitability: cast steel, Mn hard steel, chilled cast iron, common open hearth steel, Cr steel and Mn steel. The properties of these materials are dealt with. GN (3)

The Properties of Some Silico-Manganese Steels. G. Burns (Research Department, Woolwich). *Iron & Steel Institute, Advance Copy* No. 6, May 1932, 22 pages.

The results of an extensive study of the properties of steels containing as much as 2.6% Si and 2% Mn are reported. The C ranged from 0.36 to 0.54%. In normalized steels suitable for structural purposes, both Si and Mn raised the elastic limit, yield point, and tensile strength, and lowered the elongation and impact values. With more than 1% Mn, over 1% Si produces quite low impact values. It is doubtful if any of the high-Si steels show properties that can not be equalled or excelled by Mn steels with normal Si. In the hardened and tempered condition, both Si and Mn increase strength and lower ductility. Mn has the greater effect. The Si-Mn steels require a high quenching temperature. These steels are quite susceptible to mass effect, and it is sometimes desirable to quench in water. Steels that are to be quenched in water should not contain over 0.45% C. Mn is more effective than Si in decreasing the mass effect. Steels lying at the extreme limits of composition usually specified for heat-treated springs were investigated. The yield ratio increased with the Mn content. Fatigue tests indicated that a high-Si, low-Mn steel was less resistant to surface irregularities than other steels. On the other hand, the steels with a low Mn content are more readily decarburized. 18 references. JLG (3)

The Effect of Cold Working Prior to Heat Treatment on the Physical Properties of Steels. (Der Einfluss vor der Wärmebehandlung vorgenommen Kaltbearbeitung auf die Festigkeitseigenschaften von Stählen.) Erich Greulich. *Archiv für das Eisenhuttenwesen,* Vol. 5, Mar. 1932, pages 487-491.

Cold working prior to annealing generally accelerates the structure changes produced by annealing. Studies were made of 7 C-steels and austenitic Cr-Ni-steels for effect of cold rolling on changes in tensile strength and elastic limit. These properties are closely connected with transformation of banded pearlite into granular cementite and also with precitation hardening during heat treatment. Composition of the 7 steels studied is given in following table:

		Composition in %						
No.	Material	C	Si	Mn	P	S	Ni	Cr
1	St C 16.61	0.12	......	0.40	0.017	0.024	......	......
2	St C 25.61	0.29	0.06	0.40	0.020	0.013	......	......
3	St C 45.61	0.46	0.30	0.75	0.021	0.028	......	......
4	St C 60.61	0.61	0.34	0.83	0.022	0.016	......	......
5	Ni steel	0.18	0.26	0.49	0.020	0.021	5.14	0.03
6	Stainless steel	0.19	0.56	0.45	0.019	0.010	0.56	14.50
7	Stainless steel	0.37	......	2.02	0.028	0.033	35.20	10.50

With C steels containing more than 0.3% C crystal change of cementite and softening of steel by annealing below A_1 are rapidly accelerated by cold rolling. Ordinary C steels are strengthened from annealed condition greater by cold rolling and also are weakened quicker by annealing in range of decreased tensile strength, than steels with banded pearlite. With Cr-Ni steels, increase in tensile strength and elastic limit as affected by precipitation hardening was greater after slight amount of cold rolling and could be produced with shorter annealing time, as well as any higher range of temperature than with cast steels. With about 10% cold rolled reduction, amount of improvement in physical properties is decreased, and from 10% up to roughly 25% no further increase in tensile strength and elastic limit was obtained. With very uneven cold rolling, carbide segregation during subsequent annealing led to cracks. Effect of cold rolling, approximately 25% cold roll reduction, followed by annealing below A_1 on the physical properties of 6 steels is given in table below, each cold rolling was approximately 5% cold roll reduction:

		Number of Cold Rollings and Intermediate Anneals					
Material	Property	Original	1	2	3	4	5
	T. S. Kg./mm.²	22.9	21.9	22.6	20.6	25.0	18.4
St C 16.61	Y. P. Kg./mm.²	39.6	38.5	38.6	37.2	36.6	34.8
	$Elong._{10}$ — %	28.6	29.3	31.0	35.0	32.2	35.0
	T. S. Kg./mm.²	29.2	27.1	24.4	21.6	26.6	28.4
St C 25.61	Y. P. Kg./mm.²	48.9	45.9	43.0	42.5	42.9	41.1
	$Elong._{10}$ — %	27.9	24.9	26.0	31.0	33.1	(22.7)
	T. S. Kg./mm.²	36.1	42.7	30.3	28.0	35.3	......
St C 45.61	Y. P. Kg./mm.²	64.4	61.5	55.2	52.9	52.2	......
	$Elong._{10}$ — %	21.1	18.2	26.0	25.5	27.0	......
	T. S. Kg./mm.²	45.7	57.3	50.0	41.8	43.8	44.0
St C 60.61	Y. P. Kg./mm.²	80.7	76.2	68.5	63.0	64.6	60.4
	$Elong._{10}$ — %	14.8	18.0	19.0	22.0	26.3	(20.0)
	T. S. Kg./mm.²	43.3	33.3	32.3	......	32.1	31.1
Stainless	Y. P. Kg./mm.²	69.9	55.1	53.7	......	51.5	53.6
steel	$Elong._{10}$ — %	19.4	22.2	23.1	......	29.5	30.2
Stainless steel	Y. P. Kg./mm.²	63.5	63.4	63.0	62.0	60.5	......

DTR (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION OF METALS & ALLOYS (4)

Note on the Interaction of Aluminum and Water Vapour. Richard Seligman & Percy Williams. *Institute of Metals, Advance Copy* No. 597, Mar. 1932, 4 pages.

Briefly reviews conflicting results reported on reaction of Al with steam. Subjected Al sheets of varying purity and an Al-Si alloy to steam at 300-350° C. No serious attack was observed, even when air was excluded from the system. Care was taken to prevent contact of the samples with liquid water. 5 references. JLG (4)

The Phenomenon of "Friction-Oxidation" with Electrolytic Copper. (Die Erscheinung der Reiboxydation an Elektrolytkupfer.) M. Fink & U. Hofmann. *Zeitschrift für Metallkunde,* Vol. 24, Mar. 1932, pages 49-54.

The friction set up between two Cu discs under a load of 40 kg., rotating at 250 r.p.m. with and without slip was measured as a function of time in an Amsler friction machine, in an atmosphere of air, nitrogen, and oxygen, and the abraded dust collected for chemical and X-ray crystallographic analysis. The powder formed in air increases in oxygen content as the test proceeds, is mostly Cu_2O but contains some CuO with Cu present also. Practical examples of the process of "friction-oxidation" are discussed. RFM (4)

Resistance of Copper and Its Alloys to Corrosion. (Le cuivre et ses alliages devant la corrosion.) A. Matagrin. *Industrie chimique,* Vol. 18, Mar. 1931, pages 160-163; May 1931, pages 317-318.

Describes the chemical properties of cuprous oxide, resistance of Cu to atmospheric corrosion, resistance of cuprous oxide to mineral acids and resistance of pure Cu to organic reagents. WHB (4)

The "Fogging" of Nickel. W. H. J. Vernon. *Institute of Metals, Advance Copy* No. 600, Mar. 1932, 14 pages.

Describes a study of the characteristic filming or "fogging" that occurs on polished Ni. By exposing similar samples in transparent and opaque jars it was observed that light increased the rate of fogging. In the early stages the film consists of Ni SO_4 with free H_2SO_4. In the later stages it consists of basic Ni SO_4. The conditions most favorable for forming the Ni film are not favorable for the tarnishing of Cu. The fogging of Ni is attributed to the catalytic oxidation of atmospheric SO_2 at the Ni surface. The formation of the film may be largely suppressed by preliminary exposure to dilute H_2S, which supposedly poisons the catalyst. Fogging may be prevented by alloying Cr with the Ni. It cannot be suppressed by producing an oxide coating by heating to low temperatures. 6 references. JLG (4)

Grain Size, Eutectic Alloys and Corrosion. (Korngrösse, Eutectikum und Korrosion.) M. Werner. *Zeitschrift für Metallkunde,* Vol. 24, Apr. 1932, pages 85-87.

A discussion of the corrosion of Pb. Large grains increase corrosion. It is shown that impurities which form solid solutions increase the grain size greatly. Local galvanic elements may afford corrosion protection, if the addition forming the local element is more noble than Pb. This effect is lost if the addition forms appreciable quantities of eutectic with Pb, though if the addition is worked into Pb mechanically (rather than melted with Pb) the effect may again be present. RFM (4)

The Influence of Moisture on the Reaction Between Sulfur and Silver. John Wm. Smith. *Journal Chemical Society,* Apr. 1931, pages 860-863.

To determine if moisture is necessary for the reaction between S and Ag, experiments were performed in which powdered S in contact with Ag-strips was sealed in glass tubes with and without P_2O_5. In the tube containing moisture the Ag strip was appreciably tarnished within a day, and after a year had almost entirely disintegrated. In the tube containing P_2O_5, however, the strip remained completely unchanged for a year, increasing the temperature up to 150-160° C. having no effect. Drying with $CaCl_2$ instead of P_2O_5 also inhibits the reaction considerably. It is shown that the reaction is not dependent on the presence of O_2. Ha (4)

Some Causes of the Staining of Strip Brass in Process. Charles K. Skinner. *Metal Industry,* N. Y., Vol. 30, Apr. 1932, pages 140-142.

Brown, black and red stains result from the annealing operation or from the combination of annealing and pickling. Black stains appear readily on annealing in an oxidizing atmosphere. Red and brown stains from annealing are scarce. Red stains are caused by pickling stock in hot solutions or in solutions having high localized acid concentration if stock has black oxide of Cu on it. Another common cause is having 2 adjacent laps of coiled stock whose surface is covered with oxide, in contact while pickling. Impure wash water brings about staining. With proper annealing equipment to eliminate oxidation and with proper attention to the other factors, red stains can be practically prevented. PRK (4)

The Protection of Magnesium Alloys Against Corrosion. H. Sutton & L. F. Le Brocq. *Engineering,* Vol. 132, Dec. 18, 1931, pages 771-772.

Condensed from paper read before the Institute of Metals, Zürich, Sept. 14, 1931. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA6. LFM (4)

Corrosion of Steels at High Temperature. L. Losana. *Industria Chimica,* Vol. 6, Jan. 1931, pages 11-15; *Vancoram Review,* Vol. 2, Oct. 1931, pages 147-148.

24 samples of steel with different contents of Ni, Cr, W, V, Mo were exposed to the action of air as well as to exhaust gases at 600°-1050° C. Mo was found to retard corrosion greatly, with low as well as high Ni. W had little influence except in combination with Mo. V above 1% increased corrosion. The results are of the same order in air as those in exhaust gases. Ha (4)

Water Pipe Conduits with Protective Layers on the Inside. (Wasserleitungsröhren mit innen angebrachter Schutzschicht.) *Die Röhrenindustrie,* Vol. 24, July 2, 1931, page 159.

The various methods leading to the formation of an inside protection (a) while being in use and (b) to the artificial protective layer before the installation, are reviewed. The latter group refers mainly to a discussion on galvanized tubes and pipes with bituminous and concrete layers. The utilization of Pb and Cu pipes is considered. EF (4)

Corrosion in Spots Through Drops. (Lochartiger Anfrass durch Tropfen.) W. Werner. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

The author endeavored to prove experimentally Evans prediction on the electro-chemical mechanism of spot corrosion under a drop of water. This was made possible by electrically isolating from its surrounding part of the iron surface below the drop of water. The largest e.m.f. measured was somewhat above 100 mv. It is further shown that aired electrodes are nobler than electrodes which are not aired when whirls of water are absent. Evans theory fits the observations of the authors, but they contradict the theories which have been developed by Maass & Liebreich. GN (4)

Effect of Oxygen Concentration on Corrosion Rates of Steel and Composition of Corrosion Products Formed in Oxygenated Water. G. L. Cox & B. E. Roetheli. *Industrial & Engineering Chemistry,* Vol. 23, Sept. 1931, pages 1012-1016.

Bibliography of 20 references. With varying amounts of O in water, the corrosion rates of steel are shown to be proportional to the O concentrations approximately for concentrations below 5.5 cc. per liter. At higher values the relationship is not linear, and the deviations become more pronounced as the O concentrations increase, indicating that the resistance to the transfer of O to the metal surface increases because of changes in the nature of the corrosion products. MEH (4)

Corrosion Rates of Steel and Composition of Corrosion Products Formed in Oxygenated Water as Affected by Velocity. B. E. Roetheli & R. H. Brown. *Industrial & Engineering Chemistry,* Vol. 23, Sept. 1931, pages 1010-1012.

It has been found that, as the rotational velocities of steel in oxygenated water increased, the corrosion rate increased to a maximum, decreased to a very low value, and increased again to a somewhat higher value at very high velocities. The variations in corrosion rate are due to (1) differences in the type and uniformity of corrosion-product film formed, (2) changes in liquid-film thicknesses, (3) erosion. (4)

Corrosion and Its Technological Aspects. (Die Korrosion in ihre technologischen Zusammenhängen.) E. H. Schulz. *Paper before the First Corrosion Congress of the Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde, Verein deutscher Chemiker,* Oct. 20, 1931, Berlin.

The process of corrosion of a metal under given conditions can safely be judged only when all factors that affect the process are known. Some examples are given which show that in many cases slight differences in the nature of the corroding medium have a much greater effect upon corrosion than have variations of composition of the material subjected to corrosion. It is incorrect to speak of corrosion resisting alloys; there are only materials which are resistant to one or several media of corrosion. The factors which influence corrosion are classified: (1) composition and treatment of the material, (2) construction and shape of the material, (3) the media of corrosion which, in turn, are subjected to a great variety of conditions, (4) additional conditions such as wear, vibrations, stray currents and others. The importance of many individual effects upon corrosion is still underestimated. GN (4)

The Fight Against Rust. (Im Kampf gegen den Rost.) H. Wehner. *Gesundheits-Ingenieur,* Vol. 54, Jan. 3, 1931, pages 1-6.

Free and combined CO_2 as factors which cause rust are discussed. WHB (4)

Intergranular Corrosion. *Chemical & Metallurgical Engineering,* Vol. 39, Mar. 1932, page 129.

Abstract of paper by P. Payson given before American Institute of Mining and Metallurgical Engineers, Feb. 1932. Intergranular corrosion of steel of the 18-8 class is discussed. See *Metals & Alloys,* Vol. 3, Aug. 1932, page MA 238. (4)

The Results of Accelerated Corrosion Tests on Stainless Steels (Résultats d'essais activés de corrosion sur aciers inoxydables). Jean Cournot. *Comptes Rendus,* Vol. 193, Nov. 30, 1931, pages 1091-1093.

The author describes the results of a number of corrosion tests made on stainless steels conforming to specifications laid down by the Services Techniques de l'Aéronautics francaise. 7 of the 18-8 type, one containing 10% Cr and 23% Ni, 2 containing 3% Cr and, as a basis of comparison, a pure Fe. The test methods used were as follows: (a) alternate immersion over periods of 10, 20, and 50 days; (b) spray tests over periods of 10, 20, and 50 days; (c) perhydride tests over periods of 1, 2, and 3 days. Artificial sea-water, made to specification, was used. The loss in weight, the breaking stress and deflection in stamping (presumably Erichsen test, and the appearance of the pieces were carefully noted. Cournot concludes that the perhydride test is less sensitive than the others but has the advantage of being extremely rapid. The alternate immersion and emersion method gives the most regular results, particularly in so far as loss of weight measurements are concerned. The spray test shows up variations in mechanical properties due to the formation of pits in the samples. In the stamping test, determinations of breaking strengths are definitely more valuable than deflection determinations. It is concluded that the results obtained by the different methods referred to allow a very clear idea of the resistance of these steels to corrosion. The article is accompanied by a diagram showing the results of the loss in weight measurements obtained. OWE (4)

Special Austenitic Steels for Severe Corrosion Resistance. James A. Parsons, Jr. & Earl Ryder. (Duriron Co.) *Metals & Alloys,* Vol. 3, Mar. 1932, pages 56-60.

The authors discuss the requirements for metal parts in steel pickling equipment where the corrosive is acid with very substantial amounts of ferric and ferrous salts in solution. They describe their methods of test which have been arranged to give as near as possible the service corrosion conditions. Ni-Cr austenitic steels from 8-35% Ni and 2.5-18% Cr, sometimes with small percentages of Mo and Cu added, were tested. The effects of heat treatment and C content upon the intergranular attack are discussed. Suitable increase in Cr, lowering the C content, and the judicious use of added elements are the means of avoiding the intercrystalline attack. WLC (4)

Guarding Against Corrosion in Acetic Acid Equipment. D. F. Othmer. *Chemical & Metallurgical Engineering,* Vol. 39, Mar. 1932, pages 136-139.

Anhydrous acid dissolves or disintegrates fibrous materials such as wood and packing material. Use of wood is limited to strengths of acid up to 25%. Rubber hose is extensively used for handling cold vinegar. Wrought Fe and mild steels are not satisfactory materials. Cu has a satisfactory life in all concentrations and temperatures if liquid is free of dissolved oxygen: Cu vessels and tubing have been successfully Ag-plated to give almost perfect resistance to hot acid vapors mixed with air. Al bronze castings are satisfactory if free of pores. Duriron is unaffected by acid of all concentrations and temperatures even in the presence of oxygen, and it is used in contact with Cu. The latest improved technique of welding of stainless steels of low C content removes the danger of cracking when such joints are used in vinegar or stronger acid. Thin parts made of Ta which has almost perfect resistance to acetic acid, are electroplated with base metal to desired thickness and strength. Pure acid containing less than 4% water has no effect on Al: however if formic acid is present as an impurity, corrosion occurs. PRK (4)

Corrosion and Erosion. *The Steam Engineer,* Vol. 1, Apr. 1932, pages 295-297.

A review is given of the causes of corrosion under different conditions met with in steam plant operation. AHE (4)

Electrical Methods Proposed for Preventing Scale and Corrosion in Steam Boilers. Wm. L. DeBaufre. *Combustion,* Vol. 3, May 1932, pages 21-29.

Comprehensive discussion of 4 proposed electrical methods, (1) Nee-wat system; (2) Kirkaldy system; (3) Hauptvogel system; and (4) Agfil system. Theories and principles involved are explained. Operation of some of the principal methods is described. The writer concludes that there may be some merit in electrical methods of preventing scale and corrosion in steam boilers, but that such methods may not be a preventative in all cases. In any such application the complicated arrangement of tubes, drums, etc. in a modern steam boiler makes it practically impossible to obtain a uniform effect of the impressed electrical current throughout the whole structure. Considerable research will probably be required to make definite determinations, and also whether electrical methods have any advantages over chemical methods or both methods should be used. DTR (4)

New Developments of the Condenser-Tube Problem. Siegmund Hirsch & Alfred Schimmel. *Shipbuilder,* Vol. 38, Mar. 1931, pages 194-195.

In a review of the methods adopted to prevent condenser tube corrosion both in the manufacture of tubes and in their subsequent treatment, it is stated that the reports of the German Corrosion Committee show that it has been possible by these means to appreciably reduce the corrosion in condensers of reciprocating steam engines, but that much damage is still experienced in turbines. Reference is also made to the difficulties encountered in the manufacture of Ni-Cu condenser tubes and to the improvements which have been effected in recent practice. The 80% Cu, 20% Ni alloy is considered the most suitable. WHB (4)

Protective Coatings in Water-Tube Boilers and Steam Turbines. Clarence J. Hunter. *Steam-Plant Engineering,* Vol. 1, Feb. 1932, pages 37-38.

A general discussion. AHE (4)

Tube Failures in 1,400 lb. Boilers. *Power,* Vol. 74, Oct. 13, 1931, pages 542-543.

A report presented at the annual meeting of the German Association of Boiler Owners, 1931. The greatest difficulty encountered in operating the 100 atmosphere pressure boilers at Mannheim was corrosion of boiler tubes. The failures are described in detail with the various treatment methods used. There is no fundamental connection between corrosion and high pressure. Mo steel tubes were used, thus permitting thinner walls due to higher yield point. AHE (4)

Steel, Iron and Alloys. C. E. Plummer. *Factory & Industrial Management,* Vol. 8, Jan. 1931, pages 50-51.

A list of 186 American alloys is tabulated which are grouped as follows: 1. Light-metals, resistant against atmospheric corrosion; 2, Cr alloys, stainless steels, resistant against atmospheric corrosion and HNO_3; 3. Cr alloys, very resistant against atmospheric corrosion and oxidation at high temperatures and HNO_3; 4. Cr-Ni-alloys, resistant against atmospheric corrosion, oxidation at high temperatures, and HNO_3; 5. high Cu-containing bearing metals, very resistant against atmospheric corrosion and H_2SO_4; 6. Ni-Cr alloys, same as 3; 7. Si alloys, resistant against H_2SO_4; W alloys, resistant against corrosion and wear. The components are Al, Cr, Co, Cu, Mn, Mo, Ni, Si, W, C. Ha (4)

The So-Called "Non-oxidizing," Chemically Resistant Steels. (Les Aciers chemiquement resistants dits "inoxydables.") A. Portevin. *Revue Universelle des Mines,* Series 8, Vol. 7, Feb. 15, 1932, pages 198-223.

The various forms and causes of corrosion of steel are reviewed and the means so far used to reduce or eliminate this corrosion by addition of other materials are discussed. These additions must be, by nature, nobler, less liable to attack or passive by forming a protective film; they must be able to enter into solid solution with the steel. The latter property increases with the increase of the melting point of the alloyed elements and with the chemical proximity of these elements in the periodic system, and further with the similarity of the crystalline system. These items are treated in detail and the various forms of structure (martensitic, austenitic, etc.) explained in their relation to corrosion. The fields of application of rustless steels, particularly in the chemical industries are reviewed. Ha (4)

Dissolution Velocity of a Few Zinc-Silver Alloys in Acids. (Lösungsgeschwindigkeit einiger Zink-Silberlegierungen in Sauren.) M. Centnerszwer & M. Straumanis. *Zeitschrift für physikalische Chemie,* Vol. 156, Sec. A, Aug. 1931, pages 23-27.

It is found that Ag accelerates the dissolution velocity only if other, also accelerating additions, are present. In certain Zn-Ag alloys the velocity constant varies in the same magnitude as the molecular conductivity as required by the theory of local elements. Ha (4)

Corrosion by Underground Waters. N. Simpkin. *Iron & Coal Trades Review*, Vol. 124, Mar. 4, 1932, page 402; discussion, Mar. 25, 1932, page 513; *Colliery Guardian*, Vol. 144, Mar. 18, 1932, pages 538-540.

The extreme importance for mining operations of the quality of the water occurring underground is pointed out in its bearing on the equipment, pumps, fittings, pipes, boilers, etc. Especially dangerous is the liberation of hydrogen by the action of acid waters on steel pipes. Methods for overcoming the difficulties and resulting damage and danger are discussed at great length. VVK + Ha (4)

Pipe Line Corrosion and Soil Conductivity. *Engineering News Record*, Vol. 107, July 23, 1931, page 135.

Observations of corrosion, electric current and soil conditions on 9 pipe lines, made by the Bureau of Standards, led to the conclusion of a definite correlation between pipe corrosion and soil resistivity. Where soil conductivity is high, corrosion occurs. A method of measuring soil resistivity with 2 oak rods tipped with Fe, one carrying a small flash light battery and the other, a milliammeter with 100 milliampere scale was used. The rods are pushed down into the ground about 8″ apart. The soil resistivity was measured along pipe lines and all stretches in which the soil was abnormally conductive were found to be regions of corrosion trouble and, generally, of current departure. The soil resistivity at such places was usually below 500 or 600 ohms/ cm.^{3} With higher resistivities, no marked corrosion was found. Ha (4)

The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part III.—Final Report The Results of Three Years' Exposure at Southampton Docks. Newton Friend. *Institute of Metals, Advance Copy* No. 590, Apr. 1932, 8 pages.

Parts I and II appear in *Journal Institute of Metals*, Vol. 39, 1928, page 111 and Vol. 42, 1929, page 149. The bars were exposed at approximately half-tide level. The products of corrosion were removed and the corrodibility judged by the loss in weight. Results for 72 bars representing many ferrous and non-ferrous metals and alloys are given. Commercially pure Sn and Zn were not as resistant to corrosion as materials of lower purity. Brasses with the smallest grain size were the most resistant. Ni-Cu alloys offered great resistance to corrosion. An arsenical Cu was more resistant than As-free Cu. Tension, riveting, and cold working did not appreciably affect the resistance on Ni-Cr steels, but cracks appeared at welds in these steels. Some of the alloy steels exhibited localized corrosion. 9 references. JLG (4)

Comparisons of Electrolytic Deposits of Zinc and of Cadmium from Point of View of the Protection of Steel Against Corrosion (Comparison des dépots électrolytiques de zinc et de cadmium au point de vue de la protection de l'acier contre la corrosion). H. Figour & P. Jacquet. *Comptes Rendus*, Vol. 194, Apr. 25, 1932, pages 1493-1495.

The authors describe the results of a large number of systematic tests conducted with the view of determining the most satisfactory conditions for utilizing the 2 types of coating referred to in the title. Deposits were made upon plates of basic Bessemer steel containing 0.063% C. Variations were made in the methods of preparing the pieces before treatment, in the composition of the baths, and in the conditions under which electrolysis was carried out. Subsequent to coating, samples were submitted to 3 types of corrosion tests: (a) the salt spray at 15°-20° C., (b) warm, humid atmosphere, and (c) outside atmosphere. Corrosion was measured in 2 ways: (1) by the time of exposure after which there was a definite appearance of rust, and (2) by variations in the weight of the pieces. The results varied slightly, according to the method of producing the deposits. The results of the tests are given in 2 tables which are reproduced below. The results shown in the first table indicate that Cd offers better protection against corrosion than Zn in the salt-spray test and in the warm, humid atmosphere. In the atmospheric test, however, Zn proved to be better than Cd. It was noticed that a definite solution of the coatings, most pronounced in the case of Cd, occurred when the samples were exposed to the outside atmosphere.

Table I

Method of Corrosion	Nature of Deposit	Number of Hours of Exposure Prior to Appearance of Rust (Weight of Deposit) 200 mg./dm.^{2}	400 mg./dm.^{2}	600 mg./dm.^{2}	800 mg./dm.^{2}
Salt-spray	Cadmium	650	1075	1500	1740
	Zinc (B. cyanide)	200	960	1050	1300
	Zinc (B. sulphate)	155	615	945	1165
Warm, humid atmosphere	Cadmium	897	>5550	....	....
	Zinc (B. cyanide)	184	395	2087	2345
	Zinc (B. sulphate)	50	152	378	1525
Outside atmosphere	Cadmium	1056	1968	2736	5700
	Zinc (B. cyanide)	4416	10320	>11600	....

Table II

Method of Corrosion	Nature of Deposit	Increase of Weight (in mg./dm.^{2}) for an Exposure of 175 hr.	225 hr.	465 hr.	800 hr.
Salt-spray	Cadmium	28	30	36	43
	Zinc (B. cyanide)	32	37	73	103
	Zinc (B. sulphate)	31	42	98	148
Warm, humid atmosphere	Cadmium	25	27	30	36
	Zinc (B. cyanide)	65	77	115	150
	Zinc (B. sulphate)	70	89	140	......
		Diminution of Weight (in mg./dm.$_2$) for an Exposure of 550 hr.	1150 hr.	1680 hr.	2200 hr.
Outside atmosphere	Cadmium	40	143	212	266
	Zinc (B. cyanide)	0.6	3.7	22.8	34

OWE (4)

Copper and Brass Pipes and Tubes. Wm. G. Schneider. *Journal American Water Works Association*, Vol. 23, 1931, pages 974-992.

A general discussion of Cu and brass tubes, covering corrosion costs, health, and strength, including resistance to freezing strains. WAT (4)

The Corrosion of Iron; Protective Coatings. (La Corrosion du Fer; les Revetements Protecteurs.) M. R. Arzens. *Revue Fonderie Moderne*, Vol. 26, Feb. 25, 1932, pages 61-69.

The causes of corrosion and in particular of atmospheric corrosion are explained, the chemical transformations resulting from it for different metals and the corrosion products are described and various theories briefly discussed. The metal coatings for rust protection, oxides or salts, enamels, paints and coatings and the manner of preparation of the piece to be protected for the respective coatings are described in detail. 17 references. Ha (4)

Rust Protection of Cadmium Deposits. (Ueber die Rostschutzwirkung der Kadmiumniederschläge.) G. Buchner. *Oberflächentechnik*, Vol. 9, Apr. 1932, pages 80-81.

The paper gives the present views on the superiority of Cd plating as compared with galvanizing. The rust protective action of Cd deposits depends mainly on the nature of the metal on which the deposit is made, on the conditions of plating and the weight of the deposit per unit area. The critical thickness is about 350 to 450 mg./dm.^{2} which with a sufficient margin of safety would mean about 600 mg./dm.^{2} in practice and corresponds to a thickness of 0.0075 mm. All Cd deposits are at first porous and require a further treatment. Ha (4)

The Action of Sea-Water on Mild Steel. G. D. Bengough & A. R. Lee. *Iron & Steel Institute, Advance Copy* No. 3, May 1932, 17 pages.

An acid open-hearth steel containing 0.13% C, 0.15% Si, 0.034% P, 0.034% S, 0.46% Mn, 0.20% Ni, 0.04% Cr, 0.05% Cu and 0.02% O was used. Samples were completely immersed in stagnant sea water and in N/2 solution of NaCl at the constant temperature of 25° C. and under a pressure of 760 mm. Hg. The atmosphere in contact with the solutions was air, O_2, or A. The amounts of O_2 absorbed and the H_2 evolved were determined by ingenious methods. The weight loss was also determined. A large portion of the corrosion in sea water was found to be due to a reaction that liberated H_2, but in the absence of O_2, no H_2 was liberated even after 110 days immersion. The rate of corrosion in sea water was greater than in N/2 NaCl. The greater corrosion rate in sea water was a result of the reaction that liberated H_2. The rate of corrosion in sea water in contact with O_2 was only 20% greater than the rate in contact with air; in N/2 NaCl the rate is increased 2 or 2½ times by replacing air with O_2. It was not found possible to prepare a mixture of inorganic salts, with or without saponin, that would give the high rate of corrosion observed with sea water. The greater rate in sea water is attributed to the presence of organic matter in solution. Oxidation of sea water with permanganate decreased the corrosion rate. It is suggested that the evolution of H_2 may be an important factor in determining the adhesion of paints on steel immersed in sea water. 8 references. JLG (4)

A New Aluminum Light Alloy, Chlumin. Ichiro Iitaka. *Proceedings Imperial Academy*, Tokyo, Vol. 7, Apr. 1931, pages 161-164; *Journal Society Mechanical Engineers*, Japan, Vol. 33, 1930, pages 203-208.

Chlumin, an alloy of Al, Cr, Mg and Fe, is compared with some other well-known Al alloys in regard to its resistance to corrosion in NaCl solution and casting and rolling properties. WHB (4)

Corrosion Protection of Light Metals. (Korrosionsschutz von Leichtmetall.) L. Schiffer. *Deutsche Motorzeitschrift*, Vol. 9, Jan. 1932, pages 10-14.

In addition to the American Alclad and the German Allautal process of coating light metals by pure Al, a double coated Duralumin, designated as Duralplat has been brought on the market (German Patent 244,554) characterized by a corrosion resistant Al coated alloy subject to age-hardening (K 50). Micro-photographs are presented showing the intimate contact due to a diffusion of virgin metal and plate attained by thermal treatment. Enlargements of cross-sections of Brinell indentation marks (load 750, 1000 and 2000 kg.) are given to prove the favorable deep drawing properties of the plated surface layer which is uniformly deformed with the underlying carrier. The physical properties of Duralplat coincide with those of the Duralumin alloy 681: elongation = 15 — 18%, yield point = 26 kg./mm.^{2}, tensile strength = 38 kg./mm.^{2} Various kinds of corrosion tests in North Sea water and atmosphere showed after one year's exposure, that Duralumin lost 38% of the former elongation, 7% of its tensile strength, whereas Duralplat suffered only negligible losses of physical properties. Apart from the favorable bonding properties and the marked corrosion resistance, the resistance to mechanical wear, surface injuries, etc., are stressed in contrast to the soft surface of Alclad and Allautal. EF (4)

Intercrystalline Corrosion of Duralumin. A. J. Sidery, K. G. Lewis & H. Sutton. *Institute of Metals, Advance Copy* No. 598, Mar. 1932, 17 pages.

A short-time test for determining the susceptibility to intercrystalline corrosion was developed. In this test the Duralumin samples were immersed in a 1 *N* solution of NaCl containing 1% HCl by weight. The effects of overstraining on reaction to this test were examined. When overstrained by tension there was a slight tendency towards increased corrosion. When overstrained by compression there was a critical range of stressing, 14-17 tons/in.,^{2} which produced marked attack. From observations on samples quenched from various temperatures, it was found that those quenched from the higher temperatures were less subject to intergranular attack. Quenching in boiling water increased the tendency to intergranular corrosion. The rate of hardening at room temperatures of Duralumin quenched from various temperatures is shown in the form of curves. In general, the quenching temperature (between 470 and 520° C.) did not have a great effect on the subsequent hardening at room temperatures. 7 references. JLG (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Solubility of Carbon in Alpha Iron and Changes in Properties of Industrial Iron Produced by Heat Treatment under A_1 Point. (Sur la Solubilité du carbone dans le fer alpha et les variations résultantes des propriétés du fer industriel en cas de traitment thermique au-dessous du point A_1). E. Houdremont. *Revue de Métallurgie*, Vol. 29, Mar. 1932, pages 133-139.

The phenomena of C solution in α-Fe and the variations in properties produced by it and studied by Koester (Archiv für Eisenhüttenwesen, 2, 1929, pages 503-522) form a typical example of the precipitation hardening such as observed in duralumin. Studying the amount of C precipitated and held in solution using colorimetric C determination it was found that quenching above A_1 point has no effect on consequent hardening by aging. Quenched from 680° C. low C deep drawing steels did not stiffen when cooled in the furnace, responded to air hardening when sufficiently thin, and after water quenching and aging at 50° for 36 hours lost most of the deep drawing characteristics. Several day aging at room temperature produces the similar effect. The effect of age hardening is almost inversely proportional to the C content becoming undistinguishable at 0.6% C. JDG (5a)

Metallographic Investigations of Electric Welds. (Metallographische Untersuchungen von Elektroschweissverbindungen.) C. J. Hoppe. *Elektroschweissung*, Vol. 3, Apr. 1932, page 72.

The article summarizes the results of welding tests by Professor Paton, Kiew, Russia. The points investigated in particular are: (1) Effect of super-heating in welding on the structure and change of the mechanical properties of the base metal, (2) depth of the superheated structure of the base metal, (3) changes of the welded joints when subjected to loads (4) failures of weld seams. GN (5a)

Significance of Structure and Constitutional Diagrams for Engineering Design. D. Hanson. *Journal Institute of Metals*, Vol. 50, Feb. 1932, pages XV-XX.

The author points out that the metallurgist and the engineer, in order to fully appreciate the suitability of alloys for engineering purposes, should both possess sufficient knowledge of structure and constitution so that they supplement each other in the development of materials with desirable properties. Ha (5a)

The Macro-Etching of Aluminium-Silicon Alloys. W. Hume-Rothery. *Engineering*, Vol. 132, Sept. 18, 1931, page 383.

See *Metals & Alloys*, Vol. 2, Dec. 1931, page 301. LFM (5a)

The Constitution of the Liquid and Solid Alloys of the Copper-Gold System, Examined Thermodynamically. F. H. Jeffery. *Transactions Faraday Society*, Vol. 28, May 1932, pages 455-457.

The liquid and solid solutions are derived from monatomic molecules of Cu and of Au. PRK (5a)

On the Equilibrium Diagram of Fe-Mo-C System. T. Takei. *Kinzoku no Kenkyu*, Japan, Mar. 1932, pages 97-124; Apr. 1932, pages 142-173.

By means of thermal, dilatometric and magnetic analyses as well as microscopic examination, the equilibrium diagram of alloys containing less than 6% C in the system Fe-C-Mo was constructed as in the figure. A ternary solid solution ω which has been formerly known as a double carbide, is formed by the peritectic reaction melt + $Mo_2C \leftrightarrow \omega$, and this phase forms eutectics with other binary phases. A maximum point P was found on the monovariant curve O_2O_3 and two ternary eutectic points at O_1 and O_3 respectively. The γ phase of Fe is only stable at high temperature and is decomposed by the peritecto-eutectoid reaction $\gamma + \omega \leftrightarrow Fe_3C + \alpha$ (Fe). γ solid solution does not coexist with ϵ (Fe_3Mo_2) phase. ϵ solid solution (FeMo) is stable only at high temperature and is decomposed by the eutectoid reaction as in the binary system. Another ternary phase ξ was often observable in high Mo and high C alloys but this phase has not yet been determined well. KT (5a)

The Magnetic Transformations of Ferro-Magnetic Metals (Die magnetischen Umwandlungen der ferromagnetischen Metalle). Rud. Ruer. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 205, Apr. 20, 1932, pages 230-234.

Recent tests which were carried out with an especially sensitive apparatus have not corroborated the views of Burgess and Crowe which have been held so far, that magnetization is a reversible process. Contrary to expectation, it was shown and confirmed by tests with different kinds of iron that the magnetic conversion at heating is different from that at cooling. This behavior can only be explained by the existence of a phase conversion, that is for an allotropic conversion of the usual type. Ha (5a)

The Application of the Polarization Microscope in the Study of Copper Alloys. (Die Anwendung des Polarisationsmikroskopes bei der Untersuchung von Kupferlegierungen.) M. v. Schwarz. *Zeitschrift für Metallkunde*, Vol. 24, May 1932, pages 97-103.

A general account of the use of the polarization microscope in the study of Cu alloys. Illustrated by numerous photomicrographs, including 12 excellent photomicrographs in color. RFM (5a)

Crystallization of Metals and Alloys under Pressures up to 20,000 Atmospheres. G. Welter. *Przeglad Techniczny*, Vol. 70, 1931, pages 153-157.

See *Metals & Alloys*, Vol. 3, May, 1932, page MA 124. (5a)

On the Coarse-grained Recrystallization of Cold-drawn Seamless Mild Steel Tubes. (Ueber grobkörnige Rekristallisation kaltgezogener nahtloser Röhre aus Flusstahl.) A. Pomp & E. Holweg. *Die Röhrenindustrie*, Vol. 24, June 4, 1931, pages 133-135; June 18, 1931, pages 148-150; July 16, 1931, pages 172-173; July 30, 1931, pages 184-185.

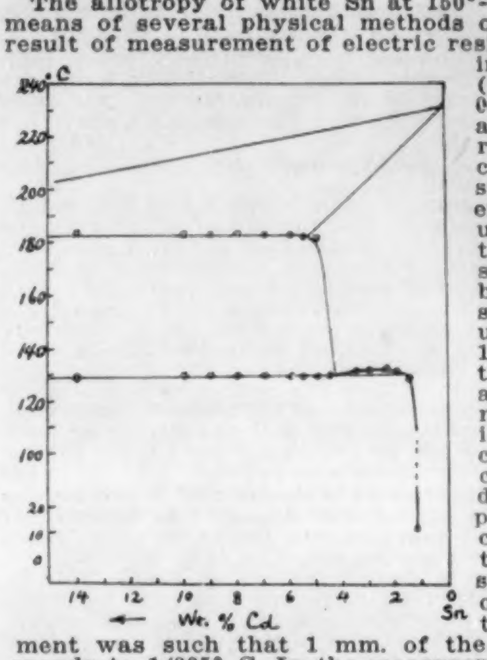
See *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 35. EF (5a)

Normalizing Automobile Sheet Steel. William F. McGarrity & H. V. Anderson. *Iron Age*, Vol. 128, Dec. 17, 1931, pages 1543-1584.

Abstract of a paper read before the American Society for Steel Treating at Boston. See "Effect of Normalizing on the Grain Structure and Physical Properties of Automobile Sheet Steel," *Metals & Alloys*, Vol. 3, May 1932, page MA 124. VSP (5a)

On the Question of the Allotropy of White Tin and the Equilibrium Diagram of the System Tin-Cadmium. Y. Matuyama. *Kinzoku no Kenkyu*, Jan. 1932, pages 1-32 (Japanese); *Science Reports Tohoku Imperial University*, Vol. 20, 1931, pages 649-680.

The allotropy of white Sn at 150°-200° C. was studied by means of several physical methods of high sensitivity. The result of measurement of electric resistance of pure Sn during cooling from melt (the cooling velocity 0.7° C./min.) showed no abrupt change in the resistance-temperature curve, but was very smooth. In the differential dilatometric measurements no discontinuity or break was observed, the neutral body being pure Ag. The sensitivity of this measurement was nearly 1/530,000. A differential thermal analysis showed also no irregularity, the neutral, in this case, being pure Cd. A silver constantan thermocouple was used for the differential couple, and a platinum gold-palladium couple for the temperature measurement of the specimen. The sensitivity of the apparatus for temperature measurement was such that 1 mm. of the scale deflection corresponds to 1/235° C. In the measurement of the thermoelectromotive force of the couple Cu-Sn, no abrupt change was observed. In X-ray analysis, spectrums were taken at room temperature and at 152-163° C., passing a constant current of 2.1 to 2.2 ampere through the specimen, and also at 220-223° C., the 3 spectrums were identical. From those results it was concluded that Sn has no transformation at a high temperature. Sn-Cd alloys were also studied by the same physical methods and offered an equilibrium diagram shown in the figure. The eutectoid transformation at 130° C. is not caused by the transformation of Sn, as it has often been assumed to be. Cd is soluble in Sn up to ½% at room temperature. See also *Metals & Alloys*, Vol. 3, Aug. 1932, page MA 240. KT (5a)



The Chromium Iron Constitutional Diagram. F. Adcock. *Engineering*, Vol. 132, Oct. 9, 1931, page 457.

See *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 7. LFM (5a)

Discussion on some Important Factors Controlling the Crystal Macrostructure of Copper Wire Bars. *American Institute Mining & Metallurgical Engineers, Technical Publication*, No. 485, May 1932, 15 pages.

Discussion of the paper by L. H. DeWald, Technical Publication No. 429. See *Metals & Alloys*, Vol. 2, Dec. 1931, page 302. JLG (5a)

Manganese has Stabilizing Effect on Critical Austenitic Alloys. Howard Scott. *Steel*, Vol. 90, Jan. 25, 1932, page 28.

An abstract of a paper delivered before the Institute of Metals division of the American Institute of Mining & Metallurgical Engineers, Boston, Sept. 1931. See "Transformational Characteristics of Iron-Manganese Alloys," *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 34. JN (5a)

The Shapes of Growth of Metallic Crystals. (Die Wachstumsformen von Metallkristallen.) G. Tammann & K. L. Dreyer. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 205, Apr. 8, 1932, pages 77-80.

How the shape of a crystal and its growth is influenced was observed by the separation of a metal from a mixture of 2 metals with widely different melting points, for instance, Cu-Bi, Ag-Pb, Zn-Pb. By changing concentration and cooling velocity the separation temperature and separation velocity can be influenced. A few drawings are given showing the shapes of crystals as they change under different conditions; the former view that crystals can only occur in polyhedric forms is not tenable, as the surface tension can at sufficiently high temperature overcome the strength of the crystal and round off its edges and corners. Ha (5a)

The Velocity of the Displacement of the Grain Borders in the Primary and Secondary Recrystallisation of Aluminum. (Die geschwindigkeit der Korngrenzenverschiebung bei der primären und sekunderen Rekristallisation des Aluminiums.) G. Tammann & K. L. Dreyer. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 191, July 7, 1930, pages 69-73.

The average number of crystals/mm.² which are formed in cold-rolled Al after annealing at 600° C. decreases from 120 after the first minute to 35 within 30 min. and after this time only little with further annealing; this is due to a continuous fine film surrounding the grains. The average linear velocity of the displacement of the grain borders decreases after the first minute from 0.0185 to 0.00011 mm. after 30 min. and to 0.0000076 mm. after 120 minutes. The direction of growth greatly influences the velocity of growth and depends also on the duration of annealing. Ha (5a)

A Study of Common Soft and Dead Soft Steels From the Point of Dilatometric Anomalies. (Etude sur des aciers ordinaires doux et extra doux notamment au point de vue des anomalies dilatométriques.) J. Seigle. *Revue de Métallurgie*, Vol. 29, Apr. 1932, pages 169-182; May 1932, pages 252-258.

Dilatation curves taken with Chevenard dilatometer having mechanical recording device on many low C steels made by 6 different methods showed that the shape of the curves might be very different particularly in regard to the A_3 point. It is affected by P content higher than 0.10%, long heating at red heat particularly in an atmosphere of hydrogen and twisting at a red heat. The orientation of specimens in regard to rolling and the gas content of steel do not seem to have any influence on the shape of the curves. See also *Metals & Alloys*, Vol. 3, May 1932, page MA 121. JDG (5a)

Some New Aspects of the Iron-Carbon Diagram. H. A. Schwartz. *Transactions American Society for Steel Treating*, Vol. 19, Mar. 1932, pages 403-437.

Includes discussion. See *Metals & Alloys*, Vol. 3, Apr. 1932, page MA 91. WLC (5a)

The Application of the Law of the Sum of the Heights in an unequilateral Triangle to Calculations in Melting Technique. (Die Anwendung des Höhensummensatzes eines ungleichseitigen Dreiecks auf schmelztechnische Berechnungen.) U. Retzow. *Die Metallbörse*, Vol. 21, June 13, 1931, pages 1107-1108; June 20, 1931, pages 1155-1156.

The utilization of the height-sum law (graphical representation of three quantities the sum of which remains constant) for the determination of the behavior of ternary compounds is dealt with in a lecture before the 91st Naturforscher Versammlung, Königsberg, 1931. Two applications are given as examples: one of which refers to a binary Sn solder and the other to a ternary Bi-Pb-Sn alloy. The graphical solution is given in detail. EF + Ha (5a)

The Transformations of Metals. (Ueber die Umwandlungen von Metallen.) Alfred Schulze. *Zeitschrift Verein Deutscher Ingenieure*, Vol. 76, Jan. 30, 1932, pages 108-112.

The transformation of metals, that is the change from one modification to another of a solid material without any change in their chemical composition, has been observed in many metals and is of great importance in explaining the nature of refining. The behavior of Fe, Tl, Ni, Co, Mn, Sn, Sb and Zr which possess distinct critical points is discussed; metals not having a critical point although formerly supposed to have, are Al, Zn, Cd, Bi, Si, Ge, Ti. The reasons for such non-existence are discussed; curves are reproduced. 63 references. Ha (5a)

On a Self-Recording Dilatometer for Quenching and the Mechanism of Nodular Troostite Formation in Carbon Steels. S. Sato. *Kinzoku no Kenkyu*, Apr. 1932, pages 174-188 (In Japanese); *Science Reports Tohoku Imperial University*, Vol. 20, 1931, pages 260-267 (In English).

A new self-recording apparatus for taking thermal expansion-temperature curves during quenching was designed. The form of curves recorded by the apparatus shows the degree of quenching efficiency of the media. During the quenching of a carbon steel, the austenite begins to be transformed into martensite at about 200° C. or at a still lower temperature in the case of oil quenching, but in the case of a more severe quench, such as water quenching, the transformation begins to take place at markedly higher temperatures, i. e., at about 300° C. The martensite expansion or the development of martensite during water quenching is greater than in the case of oil quenching. This is in good agreement with the fact that the amount of retained austenite in quenched steel is greater in the case of oil quenching than in water quenching, and also in view of the fact that the austenite $\rightarrow$ martensite transformation is much facilitated by an internal stress caused by quenching which is greater in the case of water quenching than in the case of oil quenching. The author also found that a very thin coating of fine clayey particles on the surface of the specimen considerably favored the quenching action. The author named this coating "facing." The favorable effect of the facing in obtaining a uniform quenching of the specimen is probably due to the prevention of a direct contact between the highly heated steel surface and water or oil, a rapid formation of vapor on the surface of the specimen being thereby avoided. Since the change of austenite into martensite is accelerated by internal stress, it may be expected that during the transformation, the martensite will first be formed at several centers on the grain boundary of the mother austenite, because owing to the impurities present in the steel, the crystal lattice on the boundary is much more distorted than the lattice within the grains themselves. Consequently, when the lowered Ar_1 transformation begins to take place at 500°-600° C., some portion of the austenite at several spots on the grain boundary will be first transformed into martensite. The martensite is immediately decomposed into cementite and Fe, and as this change being accompanied by recrystallization, the characteristic pattern of martensite is destroyed. This process starts from various points where the stress is especially great and extends in every direction independent of the orientation of the austenite, resulting in a structure which we call nodular troostite. In the case of a rolled and quenched specimen a banded troostite is sometimes observed, which is attributed to the mode of distribution of impurities. KT (5a)

The Segregation Problem. (Zum Kornseigerungsproblem.) E. Scheuer. *Zeitschrift für Metallkunde*, Vol. 23, Aug. 1931, pages 237-241.

The segregation accompanying the freezing of a liquid alloy exhibiting complete miscibility in the liquid state but only partial miscibility in the solid state is studied mathematically and experimentally. Upon the assumption of immediate diffusion in the liquid state and of the absence of diffusion in the solid state during the freezing process, the following equation for segregation is developed: $l = \left(\frac{c}{y}\right)^{\frac{p}{p-1}}$, where l = quantity of remaining melt, c = original composition of melt in second metal, y = composition of remaining melt in second metal, and p = distribution coefficient of second metal between melt and separated solid. Equations are developed for the additional cases in which p is not a constant: (a) when p is a linear function of y, and (b) when p is a quadratic function of y. The application of these equations to segregation in alloys of Al with Cu, of Al with Zn, of Cu with Zn, and of Cu with Sn was studied experimentally. It was found that the α solid solutions of Cu in Al and of Sn in Cu form from a melt with almost no diffusion in the solid state, but that the α solid solution of Zn in Al forms with appreciable and that of Zn in Cu with almost complete diffusion in the solid state. RFM (5a)

Structure & X-Ray Analysis (5b)

A Gas X-Ray Tube for Crystal Structure Analysis. H. Kersten. *Review of Scientific Instruments*, Vol. 3, Mar. 1932, pages 145-150.

The necessary intensity of X-ray beams for crystal structure analysis was obtained by providing sufficient cooling to allow for large current carrying capacity by making use of cellophane windows and by placing the slit in the evacuated system so that a close approach to the target is possible. The construction is described in detail and a few Laue-pattern photographs illustrate the results obtainable. Ha (5b)

The Mechanism of the Allotropic Transformation of Cobalt and Thallium. (Ueber den Mechanismus der allotropen Umwandlung von Kobalt und Thallium.) U. Dehlinger. *Metallwirtschaft*, Vol. 11, Apr. 15, 1932, pages 223-225.

10 references. Similar to Co, Tl has a hexagonal lattice which changes to a face centered cubic at 231° C. By slow cooling from a melt large hexagonal single crystals of Tl were obtained which broke up after heating above 230° C. and cooling. This shows that a cubic single crystal must first have been formed from the melt. In the cubic to hexagonal transformation that plane of the 4 crystallographically equal ones is preferred which is most nearly parallel to axis of the rod, because thereby the least surface enlargement occurs. The energy necessary to produce a transformation increases with decreasing grain size and with a grain size of .1 μ the energy is of the order of the total transformation heat. It is proved by thermodynamics that thereby a temperature hysteresis occurs, that the temperature of the cubic to hexagonal transformation is considerably lowered independent of the rate of cooling. The temperature drops to such an extent that the diffusion processes at the grain boundaries which are necessary for the transformation to take place cannot proceed noticeably. In this way the transformation can be completely prevented, in the same manner as with rolled sheets and small grained powder of Co. CEM (5b)

The Formation of Superlattices in Alloys of Iron and Aluminum. A. J. Bradley & A. H. Jay. *Proceedings Royal Society*, Vol. 136A, May 1932, pages 210-232; *Iron & Steel Institute Advance Copy* No. 4, May 1932, 19 pages.

A quantitative examination has been made of the intensities of the lines of a series of powder photographs of alloys of Fe and Al in the range Fe-FeAl. All the alloy structures are primarily based on a simple body-centered cubic lattice like that of α-Fe, but a detailed examination of alloys in the annealed and quenched states gave widely differing results. Alloys quenched from 900° C. and above show a random distribution of atoms up to 25 atomic % Al. Between 25 and 26% Al there is an abrupt change in structure and cubic centers differ in composition from cube corners. The intensity measurements show that in the quenched alloys with ordered arrangement one set of positions is occupied only by Fe atoms, but the other set contains Fe and Al atoms in varying proportions depending on the alloy composition. Annealed alloys with less than 18% Al have a random distribution, and from 40% to 50% they have the FeAl type of structure exactly like the quenched alloys in this range. At intermediate compositions a new type of structure appears which is of the type Fe_3Al. In the Fe_3Al arrangement the Al atoms lie on a face-centered cubic lattice forming a superlattice with dimensions twice as great as those of the small body-centered cube. Intensity measurements have been used in order to follow out in a detailed manner the process of the building up and decay of the Fe_3Al structure. There is no precise composition at which the Fe_3Al structure can be said to begin or end, and the structure is not completely realized even at the theoretical composition. JLG + WAT (5b)

X-Ray Studies on Bi Single Crystals. A. Goetz & R. C. Hergenrother. *Physical Review*, Vol. 40, Apr. 1932, pages 137-150.

An X-ray analysis of different types of Bi single crystals is described in order to decide whether or not the difference in density, electric conductivity and thermal e.m.f. observed between Bi crystals grown within or outside of a transverse magnetic field were caused by a change in lattice spacing or due to an alteration of the lattice parameter. The Bi crystals were grown by the method described by Goetz, and the cleaved planes (111) and $(1\bar{1}1)$ were used. Two different methods have been used to measure the integrated reflected intensities for different orders. By means of a new photographic method the intensities of the first to the fifth order have been compared and no consistent change of the parameter could be found. In addition to the photographic records an ionization method of high sensitivity has been used involving a new type of X-ray spectrometer—designed by Hergenrother—in connection with a Hoffman electrometer. The photographic results were verified and the integrated intensities could be measured up to the seventh order, thus permitting much greater accuracy in the determination of the parameter than has been previously reported. Making use of Pauling and Sherman's computations of the atomic structure factor and applying an experimentally determined value of the Debye factor, the parameter along (111) was found to be 0.359 A. U. $\pm$ 0.0006 A. U. which value lies well within the limits of Hassel and Mark and is slightly larger than James' observation. The non-existence of a change in lattice structure and in parameter for the crystals grown within and outside of a transverse magnetic field shows that the electric volume effects which distinguish the 2 types of crystals can exist in spite of the unchanged conditions for the existence and distribution of the "free" electrons as given by the geometric configuration of the atoms in the lattice. Hence the cause of these effects can only be ascribed to changes of certain variations in the lattice, the period of which must be many times larger than the size of an elementary rhomboheder in order to be undetectable to X-ray analysis. This implies the assumption of very large "mean free paths" for the electrons in a crystal. WAT (5b)

The Molecular Process of Crystal Growth in Hexagonal Metals. Deposition upon Monocrystalline Hemispheres of Zinc. Paul A. Anderson. *Physical Review,* Vol. 40, May 1932, pages 596-606.
The growth of a single crystal rod of Zn is allowed to proceed from a small orifice into a mass of molten Zn and the monocrystalline hemisphere thus formed isolated by rotation of the apparatus. The hemisphere is subjected to uniform bombardment by Zn vapor and observation of the growth on its surface forms the basis of a study of the variation of depositional rate with crystal surface structure. It is assumed, with Kossel and Stranski, that the force acting upon an atom which has struck the crystal surface is qualitatively proportional to the number of contiguous lattice atoms and a "force series" is drawn listing the relative depositional energies for 11 typical positions of different surface structure. With the aid of this force series the macroscopically observed growth on the experimental crystal is interpreted in terms of atom-by-atom deposition. WAT (5b)

The Dependence of Tamman's Resistance Limits on the Crystallographic Orientation. (Zur Frage der Abhängigkeit der Tammannschen Resistenzgrenzen von der kristallographischen Richtung.) R. Glocker & L. Graf. *Metallwirtschaft,* Vol. 11, Apr. 15, 1932, pages 226-227.
16 references. Single crystals of Au-Zn alloys were prepared by melting pure Au and Zn in graphite crucibles in an atmosphere of CO_2. After X-ray examination of the 6 mm. diameter rods, specimens were chosen which were so oriented that in one case the surface of the cube, in the other the surface of the dodecahedron was exposed. Single crystals containing 52 atomic % of Au with body centered cubic lattice and regular atom distribution were treated with concentrated HCl with and without N oxides, with concentrated HCl and H_2O_2 and with aqua regia for several days. The two surfaces, containing different proportions of noble and base metals, were equally resistant to these reagents. From this result the general deduction is made that in all binary lattices in which the coördination group of the first sphere always consists of only one kind of atoms the resistance limits are independent of the crystallographic direction of the attack of the solvent. CEM (5b)

X-Ray Examinations in Practice. (Röntgenuntersuchungen im technischen Grossbetrieb.) A. Herr. *Die Werkzeugmaschine,* Vol. 36, Jan. 15, 1932, pages 1-3; Jan. 30, 1932, pages 27-28.
The article gives a general description of the X-ray radiography methods with special reference to the equipment used. The importance of the methods is illustrated by practical examples. 4 references. GN (5b)

Art and Science of Metallography. S. L. Goodale. *Heat Treating & Forging,* Vol. 18, Feb. 1932, pages 133-136.
Review of some of the information about the crystal structure of metals disclosed by X-ray studies. MS (5b)

Simplification of X-Ray Examination of Coarse Metallic Structures by Practical Means. (Vereinfachung von roentgentechnischen Grobstrukturuntersuchungen durch praktische Hilfsmittel.) W. Grimm & F. Wulff. *Autogene Metallbearbeitung,* Vol. 25, Mar. 1, 1932, pages 65-75.
The authors describe an outfit of the practical and portable apparatus for the examination in the shop and in the field with X-rays; direct inspection on luminescent screens and photographic exposure is possible. The arrangements of instruments and accessories are illustrated and directions given for protection from the radiations of the X-ray tube. In many cases tungsten-powder is recommended in place of lead powder as protection. Ha (5b)

Line Spectra of the Elements. R. C. Gibbs. *Reviews of Modern Physics,* Vol. 4, Apr. 1932, pages 278-470.
The early observations and systems are classified. A bibliography of several thousand references is given. WAT (5b)

Influence of Temperature on the Crystal Structure of Electrodeposited Antimony. H. Kersten. *Physics,* Vol. 2, Apr. 1932, pages 276-279.
It is shown by X-ray diffraction methods that "explosive" Sb is amorphous before exploding and crystalline afterward. The crystal structure of electrodeposited Sb is influenced also by the temperature of the plating bath. The electrodeposited Sb has an amorphous structure when electroplated at temperatures below 25° C. The structure changes from amorphous to crystalline between 25° and 30° C. The structure from 30° to 70° C. is nearly constant, while above 70° there are changes in the position and intensity of lines which indicate changes in the structure. WAT (5b)

A Step Further in X-Ray. Herbert R. Isenburger. *American Machinist,* Vol. 76, Jan. 28, 1932, page 133.
By shifting the tube in relation to the film during exposures 2 images of the same section are recorded. By this method the location and extent of any defect may be determined. RHP (5b)

The New X-Ray 'Microscope'. Gaylord Johnson. *Scientific American,* Vol. 146, May 1932, pages 278-282.
R. A. Millikan's "X-ray microscope," built by two of his scientific associates, for studying the atomic structure of metals is described in a popular manner with illustrations and diagrams. WAT (5b)

X-Ray Examination of Welded Parts of Steel Constructions. (Röntgenprüfung geschweisster Stahlbauwerke.) C. Kantner. *Elektroschweissung,* Vol. 3, Feb. 1932, pages 21-24.
The paper first reviews the results of previous examinations of steel constructions, deals with the equipment required and then reports the results of the author's own examinations and finally stresses the point that X-raying of structural parts while in use will find an increasing application. GN (5b)

Influence of Hydrogen Ion Concentration on the Crystal Structure of Electrodeposited Cobalt. H. Kersten. *Physics,* Vol. 2, Apr. 1932, pages 274-275.
Co crystallizes in the cubic and hexagonal systems. By means of X-ray diffraction it is shown that Co electrodeposited from high pH (alkaline) sulphate solutions has a hexagonal structure which changes into a mixture of hexagonal and cubic, as the pH is decreased. A schematic diagram of the X-ray camera is presented. WAT (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Determination of the Poisson Ratio μ of Rolled Zinc Sheets. (Bestimmung der Poissonschen Zahl μ gewalzter Zinkbleche.) H. Sieglerschmidt. *Zeitschrift für Metallkunde,* Vol. 24, Mar. 1932, pages 55-56.
Poisson's ratio is determined along different directions in rolled Zn sheet 2 mm. in thickness, and this anisotropy is found to be consistent with the crystallographic anisotropy—preferred orientations—previously observed. The Poisson's ratios observed are as follows: parallel to rolling direction 0.299, perpendicular to rolling direction 0.226, normal to sheet surface 0.324-0.315. These differences conform to previously observed differences in Young's modulus and in thermal coefficient of expansion. RFM (6)

Magnet Steels and Permanent Magnets. K. L. Scott. *Electrical Engineering,* Vol. 51, May 1932, pages 320-323.
The relationship between the remanence of a permanent magnet and its shape was derived from a great number of tests which permitted the laying out of a nomographic chart from which the physical dimensions of magnets for definite requirements can be taken. The results are discussed with respect to other magnetic quantities and are presented in curves, but no general rules can be given. WHB + Ha (6)

Recent Measuring Methods for Machine Tools (Neuere Messverfahren für Werkzeugmaschinen). E. Sachsenberg & W. Osenberg. *Zeitschrift Verein Deutscher Ingenieure,* Vol. 76, Mar. 12, 1932, pages 262-268.
The instruments and measuring methods which have lately been developed in the laboratory for machine tool investigations and machining operations at the Technical University Dresden, comprise mechanical, mechanico-optical, electrical and electro-optical processes for the determination of the magnitude and the temporal course of the forces occurring in the different machining operations. The arrangement on the machine tool and the manner of operation of the instruments as well as their records are described in detail and illustrated. Ha (6)

Elastic Torsion Testing of Steel Spring Wires. (L'essai de torsion élastique des fils d'acier pour ressorts.) M. Bonzel. *Revue de Métallurgie,* Vol. 29, May 1932, pages 229-237.
The results for the performance of helical springs based on formulas derived from tensile testing do not take into account many factors strongly affecting the performance of springs and easily shown by actual torsion testing. Several examples of this are given. JDG (6)

Wear of Gauges. *Metallurgist,* May 1931, pages 71-73.
Extended abstract of a paper by Otto Nieberding. See "Wear of Metals with Special Consideration of the Measuring Faces of Gages," *Metals & Alloys,* Vol. 2, Nov. 1931, page 255. VVK (6)

Springs and Spring Steel. *Engineering,* Vol. 132, Dec. 25, 1931, page 795.
Short abstract of the Report of the Springs Research Committee of the Department of Scientific and Industrial Research which summarizes the work which has been done by the committee and indicates lines for future research. LFM (6)

British Investigations of Steel Structures. *Engineering,* Vol. 132, Sept. 18, 1931, pages 348-352.
Describes tests conducted by the Department of Scientific and Industrial Research under the direction of R. E. Stradling and C. H. Lobban. The subjects being studied at the present time relate to the loads on floors, strains in buildings, analysis of stress, specifications and properties of materials, properties of welded connections, and the effects of vibrations. Illustrations are given of the various types of equipment used. LFM (6)

The Properties of Cold Drawn Bridge Wires. *Engineering,* Vol. 132, Aug. 14, 1931, page 204.
Summary of a paper by L. S. Moisseiff. See "Investigation of Cold Drawn Bridge Wires," *Metals & Alloys,* Vol. 2, Aug. 1931, page 143. LFM (6)

Procedure for the Notched Tensile Test. (Die Praxis des Kerbzugversuchs.) W. Kuntze. *Metallwirtschaft,* Vol. 11, Mar. 25, 1932, pages 179-184.
Contains 5 references. Only 3 cornered notches of variable notch angle and notch depth are considered. The ends of the test bars can be either smooth, threaded or slotted. The diameter of the bar should be not over 10 mm. and its length 50 mm. for small notch angles and 70 mm. for large notch angles. The radius at the point of the notch should be .1 to .15 mm. To obtain correct and consistent results it is of utmost importance that the test bars are properly machined. The notch should be machined after the rest of the machining has been completed and the bar should be held in a chuck, not between centers. The free end of the bar must not be stressed during machining and good clearance for the cuttings is necessary. It is best to use comparatively high cutting speeds. Examples are given of the inconsistent results obtained when the machining operations are not properly carried out. However, with correctly prepared test bars the results are more consistent than in regular tensile tests. A special gage with thin pointed blades is used to measure the diameter of the notch and special holders which are suspended from centers are used to hold the test bars in the testing machine. CEM (6)

Radiographic Tests of Cast Metal and of Welds. H. H. Lester. *Engineers & Engineering,* Vol. 47, Apr. 1930, pages 77-80.
Advocates the systematic testing of castings and welds by examination of X-ray photographs and describes the beneficial application in U. S. Arsenal, Watertown. Good welding technique was achieved by correlation of various methods and the results of X-ray examination and rendered possible the extended use of welding. Some of the more common defects are explained and discussed. Ha (6)

The Upper and Lower Yield Points in Steel Exposed to Non-Uniform Distributions of Stress. G. Cook. *Engineering,* Vol. 132, Sept. 11, 1931, pages 343-345.
Contribution to the Report of the Committee on Stresses in Overstrained Materials, presented to Section G of the British Association, London, Sept. 30, 1931. See *Metals & Alloys,* Vol. 3, June 1932, page MA 168. LFM (6)

Magnetic Measurements on Rhenium. (Magnetische Messungen am Rhenium.) W. H. Albrecht & E. Weber. *Die Naturwissenschaften,* Vol. 19, Jan. 2, 1931, pages 20-21.

Magnetic measurements on chemically pure Re (less than 0.01% impurity) gave a spec. susceptibility at 18° C. of $\chi = + 0.046 \times 10^{-6}$ ($\pm$ 0.02) whereas rhenium perrhenate proved to be diamagnetic, yielding $\chi = - 0.13$ ($\pm$ 0.05) at 18° C. The Re values do not lie between the neighboring elements Os ($+ 0.074 \times 10^{-6}$) and W ($+ 0.33 \times 10^{-6}$). EF (6)

Resistance of Steels to Repeated Impacts (Résistance des Aciers aux Chocs Répétés). L. Grenet. *Aciers Spéciaux, Métaux et Alliages,* Vol. 7, Mar. 1932, pages 82-92.

Tests were made on the following steels:

	C	Mn	Si	P	S	Cr	Ni
No. 1 Low C Steel	0.12	0.40	0.15	0.019	0.009	......	......
No. 2 2% Ni-steel	0.12	0.45	0.13	0.18	0.016	......	2.10
No. 3 C Steel	0.31	0.59	0.32	0.045	0.032	......	......
No. 4 Ni-Cr steel	0.23	0.50	0.25	0.015	0.016	0.76	2.93
No. 5 Air hardening Ni-Cr	0.40	0.50	0.25	0.005	0.014	1.32	3.74
No. 6 5% Ni-steel	0.15	0.32	0.30	0.02	0.015	0.55	5.20

These tests showed that heat treatment of steel prior to its testing does not improve the resistance to repeated impact. No relation could be obtained between the elastic limit and the resistance to repeated impacts. GTM (6)

Wall Thickness and Bending Strength of Cast Iron. (Wandstärke und Biegefestigkeit des Gusseisens). Hans Jungbluth & Paul A. Heller. *Archiv für Eisenhüttenwesen,* Vol. 5, Apr. 1932, pages 519-522.

Results from the literature on transverse tests of cast iron bars of varying diameter were re-computed by 3 equations to obtain comparative data:

$$\frac{\sigma'_B}{\sigma'_B(d = 30)} = \left(\frac{d}{3}\right)^{-0.284} \qquad (1)$$

$$\frac{f\ (d)}{f\ (d = 30)} = \left(\frac{d}{3}\right)^{1.09} \qquad (2)$$

$$\varepsilon = \frac{\sigma'_B \times 1_s}{6\,E \times D} \qquad (3)$$

The equations afford simple means for critically examining various data on deflection tests. Strain number is especially useful, for, besides acting as reliable indicator of wall thickness—sensitiveness, also distinguishes cast iron quality. Transverse section—sensitiveness of cast iron serves for deflection requirements if arrangement of material is given by a Maurer cast iron—diagram. As an example of computing transverse test data on cast-iron bars of various diameters by the simplified comparative scheme, the authors use J. L. Jones' results published in *Proc. A.S.T.M.,* Vol 28, 1928, Part 1, pages 142-143.

American Data			Computed German Data				
Dia. of Bar, In.	Load lbs.	Deflection, In.	Dia. of bar, mm.	Modulus of rupture kg./mm.²	Deflection, mm.	Deflection for $\lambda = 20$	Strain No. mm. × 100 kg./mm.²
2.25	14,850	0.095	57.2	27.5	2.42	34.0	124.0
1.75	8,880	0.095	44.5	35.0	2.42	20.2	58.6
1.25	3,738	0.116	31.8	40.4	2.94	12.7	31.4
0.75	1,433	0.125	19.1	71.7	3.18	5.0	7.0

DTR (6)

Optical Polarization Tension Tests on Unsymmetrically Bent Corners and Double Bends. (Polarisationsoptische Spannungsuntersuchungen an unsymmetrischen Stabecken und an Doppelhaken.) L. Kettenacker. *Forschung auf dem Gebiete des Ingenieurwesens,* Vol. 3, Mar.-Apr. 1932, pages 71-78.

The tension ratios in curves of unsymmetrical pieces loaded for bending were investigated experimentally. In obtaining the increase in tension by calculation, an empirical formula, based on the results of numerous tests, was obtained for practical purposes. This formula can also be applied in calculating tensions on other sides and for other loads where it refers back to a simple case of the tension at the curve. Similarly, in cases of simple and momentary loading, the network of isolines and main tension spectra are obtained. The latter are particularly important, especially for use in placing reinforcements in reinforced concrete structures. In the second part of the experiment, an optical tension test on double bends was carried out. A comparison of the values of tensions obtained experimentally with the values used in ratios for sharply bent pieces indicates a remarkable co-ordination of the two. MAB (6)

New Apparatus for the Brinell Ball Test. (Nouvel Appareil pour l'Essai à la Bille de Brinell.) Guillery. *Genie Civil,* Vol. 98, Mar. 28, 1931, page 328.

Description of an improved Brinell hardness testing machine given to the Association for Testing Materials, Mar. 1931. The machines measure automatically the diameter of the impressions. See *Metals & Alloys,* Vol. 2, Nov. 1931, page 256. Ha (6)

Tests on Tin-Base and Lead-Base Bearing Metals. C. Jakeman & Guy Barr. (National Physical Laboratory). *Engineering,* Vol. 133, Feb. 12, 1932, pages 200-202.

Condensed from British Non-Ferrous Research Association; Research No. 43, Research Reports, Association Series, No. 289 A, Nov. 1931. Object of the research was to determine the comparative chemical action of lubricants on Sn-base and Pb-base bearing metals. A complete description is given of the apparatus used and the results are presented in tabular form. Results show that an alkali metal-Pb alloy will run satisfactorily at moderate loads and temperatures when lubricated with mineral oil or compounded oil, but that the alloy dissolves freely in olive or sperm oils. Neither high-Pb nor high-Sn alloys are readily attacked by mineral oil, compounded mineral oil or castor oil, but generally speaking, a higher friction loss will occur with a high-Pb alloy than with a high-Sn alloy. LFM (6)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Pitting in Nickel Solutions. W. M. Phillips. *Monthly Review, American Electroplaters Society,* Vol. 19, Apr. 1932, pages 9-11.

Paper before Chicago Branch Annual Meeting, Feb. 27, 1932. Pitting is due to dirt particles which act as insulators over small areas on which they rest. At such points the cathode potential is reduced below that of Ni deposition, but not below that required for deposition of H, Fe^{++} or Cu, if the latter metals are present in the bath. Hydrogen peroxide raises the hydrogen overvoltage and prevents H bubbles forming, thus eliminating pitting. It also oxidizes Fe^{++} to Fe^{+++} and Cu, and prevents them from depositing on the cathode and forming pits. LCP (7a)

Procedure in Plating Rolled Zinc and Zinc Die Castings. *American Machinist,* Vol. 75, Nov. 5, 1931, page 723.

Chart indicates briefly the methods and formulas of solutions used. RHP (7a)

Nickel and Chromium Plating of Aluminum Castings. (Die Vernickelung und Verchromung von Aluminiumguss.) *Deutsche Motorzeitschrift,* Vol. 8, Dec. 1931, page 418.

This note decidedly denies that Al castings could not be Ni and Cr- plated. However, scrap metal frequently remelted is unsuited due to the presence of oxides and pores. A dense casting is a pre-requisite for the successful plating operation thus restricting the use of sand castings. EF (7a)

The Structure of Nickel Deposits. (Das Gefüge der Nickelniederschläge.) Eugen Werner. *Oberflächentechnik,* Vol. 9, Apr. 19, 1932, pages 77-78.

With the present trend to rapid methods of electroplating the proper, very careful preparation of the work regardless of kind of metal, and of proper treatment and composition of the electrolytic baths is of utmost importance. A few illustrations show the most recurring defects starting formation of rust or corrosion, and hints are given to avoid them. Ha (7a)

Hot Nickel Solutions and Low pH. Alex. Regmunt. *Monthly Review, American Electroplaters Society,* Vol. 19, May 1932, pages 15-21.

Paper before Los Angeles Branch Annual Meeting, Mar. 12, 1932. Operating details for applying Ni-Cu-Ni coating to steel bumper bars to a thickness equivalent to 200-300-400 ampere-minutes respectively. The Ni bath contains 2.5 N. Ni, 0.21 N. Cl, 0.45 N. H_3BO_3 at pH of 4.0-5.4. Temperature 115° F. and current density 35 amp./ft.² Details of chemical control of all baths used are given. LCP (7a)

High Temperature Chromium Plating. A. Willink. *Monthly Review, American Electroplaters Society,* Vol. 19, Jan. 1932, pages 40-49.

Includes discussion. Paper before Philadelphia Branch Annual Meeting, Nov. 21, 1931. The author claims it is more economical to do Cr plating at 160° F. than at 100-135° F. The advantages are (1) wider plating range, (2) better throwing power, (3) increased current efficiency, (4) faster rate of plating, (5) less need for accurate control, (6) reduction of surface film of oxide during plating, (7) less porosity in deposit, and (8) harder deposit. The disadvantages are (1) larger generator required, (2) greater heating facilities required, and (3) difficulty of using stopping off materials. The bath used contains CrO_3 250 g./L., SO_4 2.5 g./L. LCP (7a)

The Chromium Plating of Pure Aluminum and Aluminum Alloys. (Das Verchromen von Reinaluminium und Aluminium-Legierungen.) K. Altmannsberger. *Aluminium,* Vol. 12, Apr. 31, 1930, pages 5-6; *Korrosion und Metallschutz,* Vol. 7, July 1931, pages 172-173.

The objects are first plated with Zn, then with Ni and finally with Cr. Conditions of deposition are discussed. See *Metals & Alloys,* Vol. 3, Aug. 1932, page MA 245. Ha (7a)

Chromium Plating Literature, (III) L. H. Decke. *Brass World,* Vol. 28, Apr. 1932, pages 74-75.

This instalment deals with analysis. WHB (7a)

Adhesion of Electrodeposited Nickel to Brass. A. W. Hothersall. *Preprint, Journal Electroplaters & Depositors Technical Society,* May 1932, pages 115-141.

Adhesion of Ni electrodeposit on Cu and brasses was tested (1) qualitatively by pulling the deposit, not less than 0.03 inch thick with pliers, and (2) quantitatively by "Ollard Test" (*Transactions Faraday Society,* Vol. 21, 1926, page 81) in terms of tons/in.² Adhesion was then found to vary according to the nature of the brass surface. While a relatively high adhesion was obtained to filed or machined brass surface, only a slight degree of adhesion, such that the deposit could be pulled off with the fingers, was found in the case of "emeried" brass. The results obtained by the tests do not indicate the true adhesion as the test pieces invariably failed in the surface layers of the brass and not at the Ni-brass interface. In the majority of cases, heat treatment of the Ni coated specimens at 250° C. for 2 hours was found to improve very considerably the degree of adhesion of Ni deposit both on surfaces not etched during cleaning, and on a Cu under-coating from the acid sulphate bath. By these methods fairly strong adhesion was obtained on "emeried" brass. The degree of adhesion was found to increase gradually with the degree of etching, and it is concluded that the poor adhesion of electrodeposited Ni which occurs on unetched emeried brass is due partly to embrittlement of the surface layers by adsorption of hydrogen and partly to the inherently weak condition produced by the emery treatment. In the case of buffed brass, it has been found that the material which is particularly weak inherently, and which is principally susceptible to hydrogen embrittlement, is confined to an extremely thin surface skin, probably less than 0.0005 mm. in thickness and that removal of this skin by means of etching treatment before deposition of Ni produces adherent deposits. Etching by means of mixed acids containing HNO_3 cannot be controlled satisfactorily. Anodic etching for 30 seconds and 10 amp./ft.² in KCN, 50 g./L., or in citric acid, 20 g./L. and ammonium citrate, 6 g./L., renders polished brass surface sufficiently etched to ensure adhesion without noticeably dimming the lustre. LCP (7a)

INDUSTRIAL USES & APPLICATIONS (9)

Aluminum Transmission Lines in Italy. (Aluminium-Oberleitungen in Italien.) *Elektrotechnische Zeitschrift*, Vol. 53, Apr. 14, 1932, page 365.

The Italian State Railways intend, in order to promote the Italian Al industry, to use Al-steel wires, with a ratio of section of steel to Al of 1:4.29. About 100 miles have already been equipped with it. The elasticity modulus of these wires is 8500 kg./mm.²; there are 30 wires of 2.7 mm. around a core of 7 steel wires of 2.7 mm., the outer diameter is 19.1 mm.; weight 0.481 kg./m., elastic limit 5100 kg./mm.², service load 1850 kg./mm.² and resistance at 20° C. 0.162 ohm./km. On another part of the lines a wire of Al alloy (Al 98.7%, Si 0.6%, MgO 4%, FeO 3%) with an electrical conductivity of 31.5 against 35 for pure Al is used. The saving in weight amounts to 55% so that this alloy is particularly suitable for long spans. The wire consists of 37 strands of 2.6 mm. The outer diameter is 18.5 mm., weight 0.558 kg./m., resistance 0.155 ohm./km., and service load 1675 kg. Joints are made of Al alloy. Ha (9)

Steel Pile Bulkhead Wall Retains Deep-Water Fill. *Engineering News-Record*, Vol. 108, Mar. 31, 1932, pages 468-470.

Use of long steel sheetpiles for deep lake seawall is unusual and new. Seven million cu. yd. fill adds 365 acres to Lincoln Park, Chicago. CBJ (9)

Brick-On-Metal Base Fails on Illinois Test Road. *Engineering News-Record*, Vol. 108, May 12, 1932, pages 694-696.

Brick pavement on sheet metal base constructed in 1930 near Springfield, Ill., has recently been destroyed and replaced. Brief description of the pavement is given, more complete details were in the Engineering News-Record, Oct. 2, 1930, page 523. The results of the experiment indicate that a bituminous-filled brick surface must be constructed on a rigid base. Flexible bases cause loosening of the bituminous filler, thereby admitting surface water and ultimately resulting in the destruction of the mastic cushion. CBJ (9)

Charging Boxes and Buggies Built of Welded Plates. *Steel*, Vol. 90, Jan. 11, 1932, page 26.

A description of the new welded steel plate charging boxes and charging box buggies in use at the open-hearth plant of the Lukens Steel Co., Coatesville, Pa. JN (9)

Designs Promote Steel Use in Residence Construction. *Steel*, Vol. 90, Jan. 25, 1932, pages 26, 28.

The construction of three different types of steel residences is being undertaken in the Cleveland district. The first frameless steel house constructed entirely of welded steel sheets, will be erected by the American Rolling Mill Co. The entire house, consisting of 8 rooms, 2 baths and a 2-car garage, will require only 14 tons of steel sheets, 16 to 20 gage, consisting of less than 100 partially assembled pieces. The exterior will be covered with asbestos sheet and the interior with Masonite insulation board. J. A. Altschuler has applied for patents on the design of a residence made up of steel units fabricated in the shop and assembled on the site by means of properly concealed steel bolts. The outside may be finished in brick, tile or stucco and the inside may be plastered and then covered with paint or paper. The Ferro Enamel Corp. will erect an 8-room residence constructed entirely of porcelain enamel on steel. JN (9)

Copper Pipe for Gas Distribution. Arthur F. Bridge & Frederic A. Hough. *American Gas Journal*, Vol. 136, May 1932, pages 48-49; *Gas Age-Record*, Vol. 69, Apr. 23, 1932, pages 503-513.

With present day construction methods Cu and steel are about equal in gas tightness. The life of gas mains depends upon varying conditions so that in certain conditions steel pipe is superior and in other conditions Cu alloy pipe will surpass. For economic calculations 30 years is assumed for the life of Cu alloy although in cases where only soil corrosion is the limiting factor, a much longer life will usually be realized. Cu pipe is probably unsuited for underground pipe in areas where stray current electrolysis is severe. Cu pipe should not be used to distribute gas containing as much as 1 grain of H_2S/100 ft.³, unless the gas is dry. CBJ(9)

New Avenues for the Use of Tin. Jerome J. Collins. *Mining Journal*, London, Vol. 177, Apr. 16, 1932, page 257.

2Fe (solid) + $3SnCl_2$ (molten) = Fe_2Cl_6 + 3Sn (molten). The Sn is deposited on the Fe, suggesting the possibility of tinning irregular manufactured articles. $SnCl_2$ can be purified by the reaction $SnCl_2 + Cl_2 = SnCl_4$, $SnCl_4 + Sn = 2SnCl_2$. On cooling the solution, $SnCl_2.2H_2O$ crystallizes. The H_2O of crystallization is evaporated, leaving molten $SnCl_2$. On electrolysis Sn is deposited at the cathode and $SnCl_4$ at the anode. The $SnCl_4$ melting at 33° C, boiling at 114° C, is highly deliquescent. H_2O can be added to it (not vice versa) to 1 part $SnCl_4$ in 5000 without hydrolysis. It can be used as an antiseptic, as a weed killer, and as a substitute for $AlCl_3$ in petroleum cracking. AHE (9)

Welded Structures, Castings and Forgings Compared. R. A. Bull. *Iron Age*. Vol. 128, Dec. 24, 1931, pages 1620-1622.

Abstract of a paper read before the National Steel Founders' Association at New York. It reviews critically the characteristics of various classes of castings, of forgings and of welded structures. See "The Selective Application of Castings," *Metals & Alloys*, Vol. 3, July 1932, page MA214. VSP (9)

Piccard's Gas-Welded Aluminum Gondola. (Die autogen geschweisste Aluminium Kugel von Piccard.) *Zeitschrift für Schweisstechnik*, Vol. 21, July 1931, page 162.

The Al-gondola of Prof. Piccard's stratospheric balloon was made of 3.5 mm. Al sheets and assembled by gas welding. Diameter was 2.1 m. EF (9)

Large Uses of Steel in Small Ways. 209th. Article. Warm Air Furnaces. *Steel*, Vol. 90, Jan. 25, 1932, page 30.

The production of warm air furnaces in the United States consumes 74,000 tons of steel annually, averaging 318 lbs. for each installation. About 15% of all furnaces built are of all-steel construction. The superiority of steel vs. cast iron "stoves" for furnaces is still a matter of controversy. The further development of air conditioning furnaces promises a greater outlet for the use of steel. These furnace units filter the air, heat it in winter, and regulate the relative humidity of the air before circulating it through the building. In summer, the air may be filtered, humidified and circulated without heating. JN (9)

VLW—Light Metals and Their Application in Mining. (Die VLW—Leichtmetalle und ihre Verwendung im Bergbau.) E. Siegmund. *Aluminium, Hauszeitschrift V. A. W. und Erftwerk*, Vol. 4, Jan.-Feb. 1932, pages 33-38.

A few examples of the use of Duralumin, Elektron, Lautal and Silumin in coal cutters, drilling machines, oxygen containers, tipples, etc. are illustrated. Savings in weight amounting to more than 50% as against steel are described in detail. Ha (9)

Aluminum in Electro-Magnetic Constructions. (L'Aluminium dans les Constructions Électromagnétiques.) P. Saurel. *Revue de L'Aluminium*, Vol. 9, Jan.-Feb. 1932, pages 1638-1642.

For very large coils the author advises the use of Al windings but these should be insulated and tightly wound; oxide insulation often causes failures. Several examples of magnetic separators, brakes, etc. are discussed. AH+Ha (9)

Construction of Bridges and Other Structures of the Deutsche Reichsbahn-Gesellschaft in 1931. (Der Brückenbau und der Ingenieurhochbau der Deutschen Reichsbahn-Gesellschaft im Jahre 1931.) Schaper. *Die Bautechnik*, Vol. 10, Jan. 1, 1932, pages 5-8; Jan. 15, 1932, pages 32-35; Feb. 5, 1932, pages 63-65.

Tests were made to determine the distribution of stresses on pillars and substructures of the bridge over the Sahle river, and to determine the coefficient of friction between the foundation and superstructures. Tests were also made on welds; static tests were made on welded seams. The corrosion-resistance of structural steels used was determined, and the effect of various protective coatings. Further investigations included the determination of the endurance strength of the steels as related to seaming and welding. Preliminary instructions on how to apply surface coatings for protection against rust on bridges are given. MAB (9)

Aluminum Foil Heat Insulation. T. A. Solberg & W. P. Sinclair. *Journal American Society of Naval Engineers*, Vol. 44, May 1932, pages 200-205; *Power*, Vol. 75, May 17, 1932, pages 717-718.

Al foil was first used as an insulator by spacing flat sheets of foil 0.0003" approximately ⅜" apart. Later it was found that good results could be obtained by slightly crumpling each layer and stacking or winding the sheets so that each sheet occupies a space of ⅜". The material is crumpled by hand just before installation. Embossed foil is used as it facilitates proper crumpling. The insulating effect of the foil is due to its high reflectivity and low emissivity. Foil 0.00045" thick is used for crumpling. A roll of foil 7" in outside diameter wound on a 1" diameter tube carries a length of 3700 ft. and weighs only 12 lb. Based on a width of 12" this makes 3700 ft.² which when crumpled rolls up into 800 board ft. of insulating space. The material is easily installed. On pipes or other surfaces where the insulation is exposed it must be protected by a heavier sheet of Al or galvanized Fe. Crumpled foil insulation has been used extensively abroad. It was found that the foil lost only about 1% of its initial reflectivity on exposure to the atmosphere. The standard salt-spray test spotted the foil in about 40 hr., and after 200 hr. small holes were present. This is an excessively severe test, and indicates that foil has considerable resistance to corrosion. Foil insulation has the advantage of (1) very low weight, (2) cleanliness, (3) resistance to distintegration and "lumping" from vibration, (4) imperviousness to water and moisture, (5) low weight and space requirement of uninstalled foil, (6) low specific heat, (7) ease of manufacture, and (8) fire resistance. It can be used at temperatures from 0 to 1000° F. A small amount of microscopic tarnish has little effect on heat insulating properties. JLG+AHE (9)

A General Study on the Strength of Materials to be Used in Boiler Construction—Investigation on Causes of Failures in Superheater Tubes (Une étude d'ensemble sur la résistance des matériaux à employer dans la construction des chaudières—Recherche des causes d'accident des tubes de surchauffeurs). G. Paris. *Chaleur et Industrie*, Vol. 13, Jan. 1932, pages 3-11.

It is possible by means of examination of inner and outer surfaces of the tubes and examination of fractures and metallographic structure of the steel to determine the causes of tube breakage. On the inside, oxidation and decarburization can be observed as well as oxidation on the outside, these resulting from action of steam and vapor at high temperatures. The critical points being in the neighborhood of the service temperature, there is a greater danger of annealing and overheating in superheater tubes than in boiler tubes. While for boiler tubes a mild steel with 0.15% C is satisfactory, for superheater tubes a metal with better resistance to heat and steam is required. The use of special alloy tubes of high price does not seem to be a considerable advance over that of C steel tubes produced by specialized manufacturers. 20 photographs and micrographs. FR (9)

Acid Resisting Metal Used for Picklers Racks. D. E. Stamm & J. C. Weaver. *Metal Progress*, Vol. 21, Mar. 1932, pages 61-64.

Pickling baskets of cast bronze, Monel, "Duraloy" (high chrome iron), "Durimet" (Cr-Ni-Si alloy), "Nichrome" and "Hastelloy" are proving more economical and safer than the archaic wooden baskets. Nichrome and Hastelloy (Fe-Ni-Mo) are especially recommended for HCl. WLC (9)

American and Foreign Automotive Steel. T. H. Wickenden. *Metal Progress*, Vol. 21, Mar. 1932, pages 57-60.

A statistical study of steels now in use in the automotive industry for the manufacture of heavy duty units. It is pointed out that the tensile strength of gear steel is less important than its capacity to resist surface wear, and that pitting on a gear is due to repeated stressing above its endurance limit in compression. Therefore case hardened gears are recommended. The tendency among foreign manufacturers is towards an increased use of alloy steels. One practice peculiar to the foreign industry is the use of an air hardening gear steel of analysis, C 0.30%, Ni 3.5%, Cr 1.50-1.75% and Mo 0.15-0.25%. A table of the British Engineering Standards Association Specifications is included. WLC(9)

Non-Ferrous Metals in the Automotive Industry. Francis A. Westbrook. *Metal Industry*, N. Y., Vol. 30, Apr. 1932, pages 145-146.

A brief survey of the diverse uses to which Al, Cu, Ni, Pb, etc., are put and the quantities involved is given. PRK (9)

Many Metals Used in Navy Dirigible Akron. *Iron Age,* Vol. 128, Nov. 5, 1931, pages 1173, 1221.

While Al and its alloys predominated in the construction of the airship, several ferrous alloys and other metals were used. The outstanding requisites in the selection of metals were strength and lightness. Alloy steels in Ni, Cr-Mo and other grades were used. Ni steel is used for outrigger fittings. Exhaust manifolds are of stainless steel. Non-magnetic alloy steel is used around the control board. Various fittings are of plain C steel. Gas and oil tanks and heating and ventilating pipes are of Al. Weight of electrical equipment is kept to a minimum by the use of Al and its alloys. VSP (9)

Ancient Volumes in Vatican Protected by Steel Shelving and Air Conditioning. *Iron Age,* Vol. 128, Sept. 3, 1931, pages 632-634.

Description of the installation by Snead & Co. of pressed steel shelves and cast iron supporting members. The air conditioning installed is the "zigzag" system developed in America. VSP (9)

Cable Reels a Growing Outlet for Steel. *Iron Age,* Vol. 128, Nov. 19, 1931, pages 1294-1296.

The advantages of steel reels are: they cannot rot; no renailing damage; rough edges cannot develop with hard usage; repair cost is low; they are exceptionally strong as to torsion, impact and crushing strains. Drums and heads are made of sheet steel in gages from No. 16 to No. 10. They are assembled by electric arc welding. VSP (9)

New Constructions of Cylinder Covers of Oil Engines. (Neue Bauarten von Zylinderdeckeln für Oelmaschinen.) E. Kleinschmidt. *A E G-Mitteilungen,* Jan. 1931, pages 7-10.

For cylinder covers which are subjected to particularly severe mechanical and thermal stresses, cast-iron has been used but this is never as reliable as steel. A new method is described by which the covers are soldered or brazed together in parts of a very high-grade steel. Ha (9)

Modern Metals for Decorating a Modern Playhouse. George Kester. *Metal Progress,* Vol. 21, May 1932, pages 25-29.

An architect discusses the application of metals in securing various decorative and architectural effects. WLC (9)

Aluminum Alloys in Transportation. A. Holyhauer. *Metal Progress,* Vol. 21, Mar. 1932, pages 37-41.

A summary of recent applications of Al base alloys in the construction of motors, aircraft, truck bodies, and railroad rolling stock. A new alloy containing Cu, Si, Ni, and Mg has a coefficient of expansion of .0000105/°F. between 70° and 212°F. This lower expansion makes the metal useful for casting pistons of low clearance. Low centrifugal force on crankshafts is attained by making connecting rod of light Al alloy (4% Cu, .75% Si, and .75 Mn) having a tensile strength of 60,000 lb./in.^{2} The increased cost of manufacturing truck bodies and freight cars of Al is offset many times by saving in dead weight. Tank cars for transportation of corrosive chemicals are constructed of corrosion resisting Al alloys. WLC (9)

Large Steel Saddle Castings. *Iron & Coal Trades Review,* Vol. 124, Feb. 12, 1932, pages 278-279.

Description of the molding and casting of the saddles for carrying the ropes of the new Hudson River Bridge. The saddles weigh 150 tons each. Ha (9)

Forming, Annealing and Polishing of Utensils of 18-8. *Metal Progress,* Vol. 21, Apr. 1932, pages 44-47.

Description of equipment and operations in the drawing of 18-8 by foremen of Lalance and Grasjean Co., Woodhaven, N. Y. The presses necessary for this material must be 3 times as powerful as those used for ordinary work in Fe or Cu. Lubrication and die clearances are similar but more annealing operations are required to prevent cracking of 18-8. 5 minutes at 1950°F. followed by air cooling is satisfactory to remove the stresses; pickling is done hot in 10% HCl followed by a dip in warm 10% HNO_3. Finishing consists of grinding with muslin wheels loaded with 60, 120, and 200 mesh grit at 2200 to 2500 r.p.m. and final buffing with tripoli and green rouge. WLC (9)

Use of High Quality Cast Iron in Constructing Machines. (Verwendung von hochwertigem Gusseisen im Maschinenbau.) *Maschinenkonstrukteur-Betriebstechnik,* Vol. 65, Mar. 5, 1932, pages 29-30.

C exists in cast Fe in the form of graphite or carbide. With the latter, when making hard tool steels, a lower Si content is used. The C content is usually held between 0.5-0.8% for machine parts, so that the amount of pearlite is greater. The bath should be carefully watched, since inclusions will form, resulting in fracture. Tensile strength can be increased with certain compositions of cast Fe by heat-treating. The varied effects of additions of Si, Al and Ni (to form graphite) and of Mn, P, Cr, S, and Mo (to form carbide) are discussed. Cr is specially advocated for hardness. MAB (9)

Use of Triple Lead Jacket Cable in Unsafe Mining Districts. (Verwendung von Dreibleimantelkabeln in Bergschädengebieten.) G. Kopplin. *Glückauf,* Vol. 68, Apr. 16, 1932, pages 373-374.

A Pb-covered jacket surrounds each Cu wire in an A.C. 3-wire mine transmission line instead of 1 Pb-covered jacket for all 3 wires, as in the common type of belt or expansion cable. This new type of cable was installed at the Hoesch-Köln Neussen A.G. Mines and physical tests were made at the Köln-Riehl Wire & Cable Works. Comparison data against single Pb jacket show an approximate 10% increase in cost, together with 4 to 15% greater life and endurance. In addition, this new cable is guaranteed to stand 5% expansion as against 1.5 to 2.0% for so-called expansion cable. In dangerous mine areas the use of triple Pb jacket cable is far superior to the old type and will prove a real economy. DTR (9)

Smoothness of Nitrided Surfaces. *Correspondence from* G. Kuwada. *Metal Progress,* Vol. 21, Apr. 1932, pages 71-72.

Nitrided spinning rings for textile machinery are proving more resistant to abrasion and corrosion than polished parts of carburized steel. WLC (9)

Why Steel Mine Cars. Donald D. Long. *Coal Age,* Vol. 37, May 1932, page 199.

Advantages of steel mine cars are discussed. CBJ (9)

HEAT TREATMENT (10)

Case Hardening & Nitrogen Hardening (10c)

Gas Carburizing Processes Receive Wide Approval. *Steel,* Vol. 90, Jan. 4, 1932, pages 162-163.

The continuous gas carburizing process is the outstanding development in heat treating practice for 1931. This process makes use of a continuous furnace and an atmosphere of flue gas (for its CO_2 content) mixed with a hydrocarbon such as methane, butane, propane or natural gas. The oil carburizing process is another noteworthy development. This process utilizes a retort furnace in which drops of oil are continually introduced and vaporized to form a carburizing gas. JN (10c)

Nitrogenization of Some Special Steels by Ammonia. (Azotowanie pewnych stali specjalnych przez amoniak.) E. Steczko. *Prace Badawcze PWU,* No. 1, 1931, pages 7-50.

20 references. The investigations demonstrated that the steels containing Cr and Al are best suited to nitrogenization, the best temperature for the process being 500° C. These steels do not show any notable surface decarburization and when nitrided thus possess the superiority over others. The annealing even at as high temperature as 700° C. does not change the sorbitic structure of the nitrided sample. On the contrary other steels, and the plain carbon steels specially, show a distinct decarburization and deterioration of the surface during nitriding. ZJ (10c)

Surface Hardening with the Oxy-Acetylene Torch. (Die Oberflächenhärtung mit der Acetylen-Sauerstofflamme.) *Zeitschrift für Schweisstechnik,* Vol. 21, Dec. 1931, pages 293-294.

The new method of the Deutsche Edelstahlwerke, Krefeld, designated as "Doppel Duro Verfahren" is intended to harden the surface of crank shafts. A flattened out oxy-acetylene torch heats up the revolving shaft, the heated zone being immediately quenched by water of 40-50° C. The depth of the hardened case depends on the revolution speed (0.15 — 0.2 m. per min.) and amounts to 2-6 mm. No warping occurs. This thermal surface hardening method costs only 1/3 of the carburizing case hardening process. EF (10c)

Surface Condition, Structure and Tensile Properties of Case Carburizing Steels in Relation to the Heat Treatment. (Oberflächenbeschaffenheit Gefügeausbildung und Festigkeitseigenschaften von Einsatzstählen in ihrer Abhängigkeit von der Wärmebehandlung.) H. Müller. *Zeitschrift des Bayerischen Revisionsvereins,* Vol. 36, Mar. 15, 1932, pages 45-47; Mar. 31, 1932, pages 61-65; Apr. 15, 1932, pages 78-79.

The experiments were carried out on one straight carbon case carburizing steel and a Cr-Ni case carburizing steel. Suitable heat treatment methods were devised for these steels in order to eliminate the formation of a cementite network. The results are as follows: The fracture, the structure, and also the tensile properties of the case hardened steels show that upon case carburizing the steel should be cooled as rapidly as possible in order to attain a fine grain in the core and for eliminating a network of cementite. The cooling velocity necessary to just avoid the formation of the cementite network depends on the type of steel and the dimensions of the case carburized piece. Higher cooling velocities are to be avoided due to the setting up of internal stresses. A difference of structure of the transitory zone between case and core of samples slowly or more rapidly cooled after case carburizing could not be observed. Subsequent annealing at 650° C. does not affect the grain size but the cementite, provided the cementite crystals are not too coarse. Coarse cementite can be avoided only by rapidly cooling after case carburizing. Annealing at 900° C. brings about a fine grain of the core. The structure of the case of samples annealed at 900° C. depends more on the cooling velocity in that slow cooling improves the structure but rapid cooling somewhat impairs the structure. If the service conditions of the piece are not such that a fine grain in the core is necessary, annealing at 650° C. is sufficient. The following procedure is given: (1) for steels to meet normal requirements: case carburizing, cooling (with a velocity according to the dimensions) annealing at 650° C., hardening of the case. (2) for steels to meet highest requirements: case carburizing, cooling, hardening of the core with a velocity which just suppresses the cementite net work, annealing at 650° C., hardening of the case. 8 references. GN (10c)

Aging (10f)

Influence of Cold Rolling Upon the Hardening of Duralumin. (Einfluss der Kaltverdichtung auf die Aushärtung von Duralumin.) K. L. Meissner. *Zeitschrift für Metallkunde,* Vol. 24, Apr. 1932, pages 88-89.

The effect of cold-rolling following the quenching upon the subsequent hardening at room temperature of duralumin was studied. It was found that cold-rolling interferes with the subsequent hardening, and that this interference is the greater the greater the amount of cold-rolling. If, however, the cold-rolling does not immediately follow the quenching, but follows 4-6 hours after quenching, the hardening process is not disturbed. RFM (10f)

Malleableizing (10g)

High Quality Malleable Casting. (Ueber hochwertigen Temperguss.) E. Piwowarsky. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 6 pages.

See *Metals & Alloys,* Vol. 2, Nov. 1931, page 265. (10g)

Annealing Furnaces for Malleable Iron. (Fours à recuire la Malléable.) Chr. Kluijtmans. *Revue de Fonderie Moderne,* Vol. 26, Mar. 10, 1932, pages 75-78.

The conditions in the annealing of malleable iron are investigated for different types of containers and different kinds of furnaces and fuels; the average costs for a great number of installations in France are tabulated. As these investigations, however, comprise quite a few obsolete furnaces the author recommends their replacement by new ones for obtaining real economies. Ha (10g)

JOINING OF METALS & ALLOYS (11)

Gas Welded and Brazed Joints for High Nickel Alloys. F. G. Flocke, J. G. Schoener & R. J. McKay. *Journal American Welding Society,* Vol. 11, Mar. 1932, pages 12-16.

Paper read before the 32nd annual convention of the International Acetylene Association, Chicago, Nov. 1931. See *Metals & Alloys,* Vol. 3, Aug. 1932, page MA 249. TEJ (11)

Tests of Joints in Wide Plates. W. M. Wilson, J. Mather & C. O. Harris in coöperation with Chicago Bridge and Iron Works. *Engineering Experiment Station, University of Illinois Bulletin,* No. 239, Vol. 29, 1931, 71 pages. Price 40 cents.

Full size tensile tests, made in a 3 million lb. testing machine, on wide plates, up to 64", indicated that such plates will give about 90% of the unit strength as determined on specimens 1½" wide. Welded butt joints in 64" plate showed as great strength as the continuous plates. The effects of different types of riveted joints, rivet spacing, the shear strength of rivets, bending in lap joints, and effects of different methods of welding lap joints are discussed. Coated electrodes developing an inert gas in melting, produced better results than those that did not contain such a gas forming coating. HWG (11)

Brazing (11a)

The Engineering Silver Solders. Ernest A. Smith. *Engineering,* Vol. 133, Apr. 15, 1932, pages 449-451.

The increased use of Ag solders for engineering purposes has led to research work on their mechanical and physical properties. The work of various investigators is summarized. The Ag content of these alloys varies from 9-10% in the lower grades to 30-70% in the medium and higher grades. The latter are Ag-Cu alloys to which Zn from small quantities up to about 20% is added to lower the melting point. The lower grades are ordinary brazing brasses containing a small quantity of Ag. The relative fusibility of Ag solders varies from 670 to 850° C. Tables are included giving melting points, mechanical properties, electrical conductivities of Ag-Cu-Zn alloys as well as British, U. S. and German specifications. The need for further research on these alloys is stressed. LFM (11a)

Distillation Phenomena During Hard-Soldering of Copper-Zinc Alloys. (Destillationserscheinungen beim Hartlöten mit Zink-Kupferlegierungen.) W. Claus. *Zeitschrift für Metallkunde,* Vol. 23, Aug. 1931, pages 243-244.

The application of diffusion equations to soldering is examined critically and limitations shown. Vaporization of one of the solder constituents invalidates such application, as in brazing Fe with Cu-Zn hard solder. RFM (11a)

Soldering (11b)

Grained Aluminum Solder (Gekörntes Aluminium-Schlaglot). L. Rostosky. *Aluminium Hauszeitschrift V.A.W. und Erftwerk,* Vol. 4, Mar. 1932, pages 73-74.

A new hard-solder for Al is described which has a melting point 120° C. lower than Al; it is made in 3 different grain sizes. Joints can be made with it which are said to be practically just as solid, corrosion resisting and of the same color as welded joints, they can be made with the ordinary Bunsen burner. Examples are given. Ha (11b)

Brazing Metals with Silver Solders. A. Eyles. *Mechanical World,* Vol. 91, Jan. 1, 1932, page 5; *Machinery,* Vol. 38, Jan. 1932, pages 348-350.

See *Metals & Alloys,* Vol. 3, May 1932, page MA 134. RHP (11b)

Soldering and Modeling of Aluminum. (Löten und Modellieren von Aluminium.) *Deutsche Motorzeitschrift,* Vol. 8. Dec. 1931, pages 420-422.

Calls attention to the present status of soldering broken Al parts. The application of the Tialit solder compound (not commercially available) is discussed and its possibility is illustrated by two motor blocks and a ventilator in the damaged state and after repair work. EF (11b)

Welding & Cutting (11c)

Welding as Used in Installing Pipes. (Rohrinstallation mit Schweissung.) *Gas- und Wasserfach,* Vol. 75, Feb. 20, 1932, pages 148-150.

With the knowledge of the value of fusion welded pipe joints increasing steadily, it becomes necessary to compare it with other kinds of welds and seams for adaptability and efficiency. Emphasis is placed on welding technique, which includes knowledge of the various methods, materials and their applicability. MAB (11c)

Electric Welding in Boiler Construction. (Elektroschweissung im Dampfkesselbau.) *Elektroschweissung,* Vol. 3, Mar. 1932, page 53.

The paper reports the experiences in welding man-holes of boilers. GN (11c)

Fusion Welding of Copper. (Sur la Soudure Autogene du Cuivre.) *Cuivre et Laiton,* Vol. 5, Mar. 30, 1932, pages 129-136; Apr. 15, 1932, pages 149-157.

The possibility of fusion welding of Cu with particular reference to its application in Cu parts of locomotives (fire boxes, water tubes, boiler, etc.) and based on experiences made by the German and Swiss state railways are discussed. A main difficulty was to get a welding electrode which would not melt before the piece itself; this happened always because the electrode used was of electrolytically pure Cu while the piece contained oxides and therefore had a higher melting point. A Swiss patent employs an electrode composed of electrolytic Cu with an addition of Ag and P with a melting point of 900° C.; it flows easily and covers the piece like solder. This same material can equally well be applied with the oxy-acetylene process. The procedures and the equipment for it are fully described, photomicrographs of the welds showing the uniform structure are given and a number of applications and preparation of pieces to be welded are illustrated. Ha (11c)

The Electric Welding of Battered Rail Ends. *Engineering,* Vol. 132, Oct. 2, 1931, page 452.

Short article describing experimental electric welding being done by the Canadian Pacific Railway. Rails rebuilt by this process were found to be in good condition after 16 months' service. When first completed the welds show a scleroscope hardness of 55 and after a few months service the hardness increases to 60-63. LFM (11c)

Welding in All-Steel Body Production. Joseph W. Meadowcroft & James J. Paugh (Edward G. Budd Mfg. Co.). *S.A.E. Journal,* Vol. 30, Mar. 1932, pages 143-149.

All-steel welded bodies for passenger cars have many advantages over composite bodies, among them being fewer parts, doors of only 2 pieces, no visible outside seams, lower tops for the same head room, less roof weight, lower center of gravity, greater safety, increased visibility, permanent quiet, economical upkeep and perfect outside lines. Wood and steel react so differently to stress that neither adds much to the strength of the other in a composite structure. Steel alone, welded into a unit structure, is lighter and less bulky. The entire side of the body is stamped from a single sheet, with the openings die formed to reenforce it. Chassis frame and body follow the same lines, so that they reenforce each other and body sills can be omitted. This plan saves 2" in height, as compared with other bodies. Flash welding is employed to join sheets 120" long and of any desired width, because mills are not equipped to produce, economically and speedily, sheets of the required accuracy. The tonneau rear seams are flash welded also, and the cowl and roof are attached by spot welding. Flash welding of the larger sheets requires uncommonly accurate alignment of the edges of the metal due to the scarfing operation which trims both sides of the weld in one operation. Magnetic clamping allows perfect alignment since the pressure is self-contained. Handling the large units for welding small reenforcements like those for hinges, locks and fender bolts can only be accomplished on a spot-welding machine of great flexibility, used in conjunction with overhead carrying equipment. Electrodes are important; most of them are of hard-drawn Cu or a material that contains a large percentage of Cu. To secure long life, electrodes are cooled to within ⅛" of their points wherever possible. The automobile body must have a certain capacity, must be strong and serviceable, must possess certain conveniences and must meet the requirements of appearance. In the all-steel body, the necessary skin or shell is utilized as the chief structural member and reenforced by additional strengthening members wherever needed. In a sedan are found 2303 spot welds and 140" of flash welding, plus the welding of the open sheets. Various applications of welding and the different methods are covered in the discussion, special emphasis being laid on the ductility of the metal in the weld. The welding of thin sheet metal is also considered. Relative tensile strengths of the weld and the parent metal are mentioned, as well as the point at which a weld ruptures. In this connection one member suggests testing the parent metal before welding and comparing the results with those obtained from the welded piece to show the effect of welding upon the metal. WAT (11c)

Basic Principles of Education and Training in Industry as They May be Applied to Welding Instruction in Trade and Vocational Schools. W. H. Magee. *Paper read before the 32nd Annual Convention, International Acetylene Association,* Chicago, Nov. 1931, 7 pages.

General requirements for teachers and curriculums. Ha (11c)

Discussion of Paper on "Resistance of Metal Fabric" by W. T. Ober. *Journal American Welding Society,* Vol. 10, Dec. 1931, pages 14-15.

Discussion of Paper presented at the Fall meeting of the American Welding Society in Boston, Sept. 1931. Paper published in *Journal American Welding Society,* Vol. 10, Sept. 1931, pages 50-52. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 43. TEJ (11c)

Discussion of Paper on "Welding Solves Another Problem" by Frank P. McKibben. *Journal American Welding Society,* Vol. 10, Dec. 1931, pages 5-8.

Discussion of Paper presented at Fall Meeting of the American Welding Society at Boston, Sept. 1931. Paper published in *Journal American Welding Society,* Vol. 10, Sept. 1931, pages 47-49. See *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 71. TEJ (11c)

All Welded Turbine Cases Built Up From Plate. A. M. MacFarland. *Welding,* Vol. 3, Jan. 1932, pages 51-54.

Procedure used in construction of an arc welded turbine case. 2,000 lbs. of heavily fluxed electrode was used. (11c)

Recent Investigations of the Gas Fusion Welding of Copper. (Neuere Untersuchungen über die gasschmelzschweissung des Kupfers.) K. Altmannsberger. *Oberflächentechnik,* Vol. 9, Feb. 2, 1932, pages 21-22.

The often observed extraordinary low strength of a Cu weld is explained by the softness of the material, which absorbs oxygen at higher temperatures. Due to its good heat conductivity a weld should have double-V-shape and should be made simultaneously from both sides with a larger burner than used for iron; the flame should be neutral and be applied to the metal vertically. After welding the seam should be hammered. Only acetylene, not hydrogen must be used, and the welding pencils should have a melting point lower than that of the Cu, i. e. 1085°C, and contain a deoxidation agent; they should be preferably of an alloyed type; suitable materials are: Be, Si, Ti, Mn, As, Sb. Fluxes must be acidic; a boric acid base with salts, for instance sodium phosphate or ferro-potassium cyanide. Ha (11c)

Welding Gas Mains in Australia. James Lyall. *Welding,* Vol. 3, Jan. 1932, pages 28-29.

The largest pipe line so far laid in Australia is an 18" diameter gas line, 12½ miles long. It was welded by the oxy-acetylene process. The author tells how a branch pipe was welded to an 8" main without cutting off the gas supply. TEJ (11c)

Practical Application of the A.S.M.E. Welding Code. A. J. Moses. *Journal American Welding Society,* Vol. 11, Feb. 1932, pages 13-15.

Paper presented at the joint meeting of the Metropolitan Section of the A.S.M.E. and A.W.S., Jan. 5, 1932. In a large measure the interest aroused by pressure vessel welding has been directly responsible for the remarkable progress made in the art during the past decade. The problem of ideal welding lies in the securement of a joint or weld metal of the same physical and chemical properties as the base material. The author discusses the advantages of welding, the variables entering into the process and the control of variables. Test data give physical properties of welds. TEJ (11c)

Discussion of Paper on "An Improved Product by the Use of Bronze Welding" by H. F. Reinhard. *Journal American Welding Society,* Vol. 10, Dec. 1931, pages 22-23.

Discussion of Paper presented at the Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in Journal of the American Welding Society, Vol. 10, Oct. 1931, pages 5-8. See *Metals & Alloys,* Vol. 3, Feb. 1932, page MA 42. TEJ (11c)

Shrinking the Scrap Heap with Electric Welding. G. N. Robinson. *Welding,* Vol. 3, Jan. 1932, pages 26-27.

The author cites many examples of how maintenance cost reduction and low stock inventory are made possible by arc welding. TEJ (11c)

Coated Electrodes. G. Raymond. *Welding,* Vol. 2, Dec. 1931, pages 789-792.

The author compares properties of open arc and shielded arc welds. Test specimens are illustrated. The shielded arc principle is explained. Part of the A.S.M.E. Pressure Vessel Welding Code is included with comments by the author. TEJ (11c)

Testing of Welding Torches for Low Pressure Acetylene. (Das Prüfen von Schweissbrennern für Niederdruck-Azetylen.) K. Poettgen. *Autogene Metallbearbeitung,* Vol. 25, Feb. 1, 1932, pages 33-36; discussion with W. Knoch, pages 36-38.

A method for testing acetylene burners proposed by Knoch is discussed and the behavior of a burner was tested as dependent on temperature and pressure in the acetylene chamber. The longer the flame burns without interruption, the more satisfactory the operation. Ha (11c)

A Revolution in Joints. G. Raymond. *Welding,* Vol. 3, Mar. 1932, pages 163-165, 187.

Presented before The Engineers Club, Oklahoma City, Okla. An engineer paints a striking picture of what the welding processes are doing to promote production in all industries. TEJ (11c)

Resistance Welding Budd Bodies. D. J. Rahn. *Welding,* Vol. 2, Dec. 1931, pages 802-803, 807.

A description of some of the difficult spot welding applications at the Budd Manufacturing Plant. Cleverly designed electrodes are used to reach out-of-the-way places. TEJ (11c)

Arc-Welding in Shipbuilding Construction. J. H. Patterson. *Welder,* Vol. 3, Jan. 1932, pages 2-5.

The reasons for the wide use of the electric arc in welding ship structures are reviewed and the great influence of proper design and reliable workmanship for saving in weight and time is pointed out. Ha (11c)

Discussion of Paper on "Welding of Copper and Brass Piping" by H. V. Inskeep. *Journal American Welding Society,* Vol. 10, Dec. 1931, pages 28-29.

Discussion of Paper presented at Fall Meeting of the American Welding Society in Boston, Sept. 1931. Paper published in *Journal American Welding Society,* Vol. 10, Oct. 1931, pages 21-24. See *Metals & Alloys,* Vol. 3, Apr. 1932, page MA 100. TEJ (11c)

The Welding of Steel Structures in Germany. Werner Boos. *Journal American Welding Society,* Vol. 11, Feb. 1932, pages 20-23.

The large number of steel structures which have been welded in Germany during the past year, e.g., railway and street bridges, shops, station halls, office buildings, cranes, etc.—give evidence of the theoretical, practical and psychological development in this sphere. The author describes some of the up-to-date welded structures in Germany. Both oxyacetylene and electric arc welding are employed, the choice depending on which is the most economical in each individual case. Welding technique and special structural steel shapes are also discussed. TEJ (11c)

Cutting Down and Re-erecting Gas Welded Tanks Economically. Marvin K. Allen. *Welding,* Vol. 3, Mar. 1932, pages 158-160.

A recent experience of cutting down by means of an oxy-acetylene torch and re-erecting an all-welded oil storage tank of 10,000 bbl. capacity demonstrated that this type of construction has a salvage value of 42% as compared to less than 10% for a riveted tank. The author tells how the job was done. TEJ (11c)

Progress in Welding in First Half of 1931. (Fortschritte in der Schweisstechnik im ersten Halbjahr 1931.) W. Lohmann & E. H. Schulz. *Stahl und Eisen,* Vol. 52, Mar. 3, 1932, pages 220-223.

Bibliographical summary of welding progress during 1st half 1931. Includes 35 references and is arranged according to following heads: (1) Effect of materials. (2) Welding methods. (3) Testing methods. (4) Properties of weld. (5) Behavior of weld in operation. (6) Constructive problems. (7) Economical problems. DTR (11c)

Method of Joining Oil Well Casing Improved by Welding. J. F. Lincoln. *Welding,* Vol. 3, May 1932, pages 305-306.

By using a welded bell and spigot joint instead of the conventional screw joint for oil well casings, the casings are easier to handle and run, the joints are stronger and more resistant to corrosion and are tighter. The author describes the procedure used in making these joints. TEJ (11c)

Effects of Machine Gas-Cutting on the Metal Cut. *Machinery,* Vol. 38, Dec. 1931, page 264.

Abstract of a paper by L. M. Curtiss entitled "Some Methods and Effects of Machine Gas Cutting." See *Metals & Alloys,* Vol. 3, July 1932, page MA 216. Ha (11c)

New Process Called Shot Welding. *Industry & Welding,* Vol. 3, Apr. 1932, page 19.

In welding stainless steel sheets a separation of the Cr at the weld points gave rise to corrosion in these spots. This was eliminated by developing a spot welding process (Edw. G. Budd Mfg. Co.) at extremely high temperature which speeded the process up to a point that the weld was made before Cr separation took place. Amperages up to 1200 are used and a time switch is set so that the current is applied from 0.01 to 0.001 sec., a time so short that metallurgical changes have no time to take place. Ha (11c)

Structural Steel Welding Report. *Journal American Welding Society,* Vol. 10, Dec. 1931, pages 38-50; Discussion, Vol. 11, Jan. 1932, pages 5-8.

This portion of the report consists of Sections 6, 7, 8 and 9 which include Miscellanea, Conclusions, Recommendations and Fields for Further Research. Important conclusions are: (1) No harmful effect on the base metal due to the welding was disclosed. (2) In this range of tests, no important difference was found in strength of welds made by any of the fusion welding processes employed—the electric arc (direct and alternating) and oxy-acetylene. (3) Specimens from a given shop tested in different laboratories gave consistent results. (4) Qualification tests of welders were reflected in their subsequent program performances. (5) Symmetrical joints of the end welded, side welded and combined types were approximately 35%, 10% and 14% stronger, respectively, than similar non-symmetrical joints. (6) Although side welds showed greater uniformity, end welds had 35% greater average strength. (7) Unit strength of a perfect small weld is somewhat greater than that of a larger one, but the variation is not sufficient to warrant the use of different working stresses. (8) Use of square butt joints should be restricted to sizes below ⅜" and the use of single V joints to sizes below ¾". (9) Unit strengths of continuous and intermittent welds were substantially equal. (10) The strengths of butt welds made in the flat and vertical positions were approximately equal. (11) For fillet welded joints, wherein bending was negligible, the average shearing strength was 42.5 kips/in.^{2} of throat. The strength of joints in which considerable eccentricity was present averaged from 22 to 44 kips/in.^{2} of throat. (12) The average strength of all butt welded specimens was 49.6 kips/in.^{2} of weld throat. (13) Average ratio of yield point to tensile strength of base metal is 60.6%, whereas average ratio for welded joints is 72.7%. (14) Minimum length of fillet welds recommended is 4 times the fillet size. (15) Qualified welders may be expected in commercial practice to produce weld strengths within 12% of a general average. Important recommendations are: (1) Recommended qualification tests for welders are outlined. (2) Permissible working stresses as recommended by the American Welding Society are endorsed—shear 11.3 kips/in.^{2} of weld throat; tension 13.0; compression 15.0. (3) Cross-section of welds should be measured by gages. TEJ (11c)

Welding Electrodes for Steel Constructions. (Beurteilung von Elektroden für Stahlbauten.) E. Klosse. *Elektroschweissung,* Vol. 3, Feb. 1932, pages 28-30.

Tells how the qualification of welding electrodes can be determined numerically with special consideration of its economies. GN (11c)

Welding of Extruded Bronze. Ira T. Hook. *Journal American Welding Society,* Vol. 11, Apr. 1932, pages 42-46; *Welding,* Vol. 3, June 1932, pages 356-360; *Industry & Welding,* Vol. 3, May 1932, pages 3-7, 30; June 1932, pages 17-20.

A discussion of the metal extrusion process as applied to Cu-base alloys, compositions of these alloys, their welding properties and welding procedure. Oxy-acetylene welding is most commonly employed. TEJ + Ha + JN (11c)

Ductility in Arc Welds with Some Reference to Strength Values. Chas. H. Jennings. *Journal American Welding Society,* Vol. 11, Apr. 1932, pages 37-42; discussion. May 1932, pages 24-25.

Paper presented at the annual meeting of the American Welding Society, New York, Apr. 1932. The author discusses the various methods of determining weld ductility and gives physical properties of several types of welds. The most satisfactory method of determining ductility properties of weld metal is by elongation and reduction of area values as obtained in the usual manner from standard ½" diameter A.S.T.M. tensile specimens. The ductility of butt welds may be obtained either from tensile tests with proper design of specimen, or the free bend test. TEJ (11c)

Holding Down Costs in Production Arc Welding. R. Kraus. *American Machinist,* Vol. 76, Jan. 28, 1932, pages 137-141.

Preliminary cutting should be accurate both to save weld metal and for a better joint. A little rust or mill scale is not harmful. Many coats of paint should be burned off with a torch. In shop welding, material ¼" thick and up to a 3/16" electrode may be used. Describes methods of forming the joints, allowance for contraction stresses, and how to overcome "blow." RHP (11c)

Arc Welding as a Maintenance Tool. H. F. Kneen. *Industry & Welding,* Vol. 3, Apr. 1932, pages 2-6.

The advantages of arc welding in maintenance and repair departments are pointed out and illustrated. Ha (11c)

The Novel Multiple Flame Torch System. A Fifty Percent Increase in Welding Speed. (Der neue Mehrflammenbrenner Keel. Eine neue 50% ige Erhöhung der Schweissgeschwindigkeit.) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 21, Feb. 1931, pages 26-38.

A multiple-flame torch is introduced including 1-3 individual flames for pre-heating of the welded material, for the welding operation itself and the eventual pre-heating of the welding rod respectively. The advantages claimed are: increase of welding speed, higher welding temperatures, and welding seams of smaller dimensions. The limit of the single torch is 100 liters acetylene per mm. sheet, while 130-160 liters C_2H_2 can be fed into the multiple-flame torch. A double flame torch is recommended for 2-10 mm. sheets and a triple torch above 10 mm. Tests are reported, showing the great efficiency of the novel welding outfit which yielded a 50% increase of the welding speed. The gas consumption is not very much lower, but the warping of the sheets is less pronounced, and the welding seam is of superior quality. The novel welding equipment is particularly suited for lap-welded joints, upright sheets and built-up welding performances. Horizontal as well as vertical seams can be made. Paper is also given in French. EF (11c)

Electric Resistance Welding. (La Soudure Électrique par Résistance.) Ad. Kloppert. *Revue Universelle des Mines,* Series 8, Vol. 7, Feb. 15, 1932, pages 270-275.

The principle of the utilization of the heating effect of the electric current for joining metals is discussed and its practical methods described. The author deplores that this type of welding has not found the same consideration in research and scientific study as other welding processes. Ha (11c)

The Growing Importance of Tests—What they Mean to the Welder and to the Welding Industry. H. L. Whittemore, John J. Crowe, A. B. Kinzel & W. B. Miller. *Paper presented to the 32nd Annual Convention of the International Acetylene Association,* Chicago, Nov. 1931, 13 pages.

The need for testing welds is discussed—tests are the only way to guarantee good welding. They are grouped in three classes: 1. Design tests to determine the value of base metal, method of welding, or design of joint. The specimens should be fabricated by a qualified welder. These tests are usually carried to destruction, the structure being unusable after test. 2. Qualification test for welders. As the properties for manual welds depend greatly upon the care and skill of the welder, materials and equipment are used as in actual production and tests made at frequent intervals to determine the welder's ability to make safe welds. 3. Product tests to insure a satisfactory product; there are destructive and non-destructive tests. The various methods for ascertaining physical properties and soundness of the weld by this group are described. Ha (11c)

Making Electrically Welded Jigs in Russia. Walter Wells. *Machinery,* Vol. 38, Dec. 1931, pages 248-249.

Deals with jig design. RHP (11c)

The Determination of the Working Time in Arc-Welding. (Die Arbeitszeitermittlung beim Lichtbogenschweissen.) M. Zscheile. *Werkstattstechnik,* Vol. 25, Sept. 1, 1931, pages 414-416.

An analytical investigation based on the volume of the seam to be welded. Ha (11c)

Applications of Resistance Welding. L. B. Wilson. *Welding Journal,* Vol. 28, Nov. 1931, pages 339-340, 352.

Paper read before the members of the Northwestern Branch of the Institute of Welding Engineers, Oct. 13, 1931. Necessity of reducing production costs has been the chief factor in the rapid progress made in applications of resistance welding. First employed in welding of cycle and motor rims, this process is now used for welding not only mild steel, but also malleable cast Fe, high C steel, Cu, brass and most of the commercial alloys. Parts to be welded should have equal sections, be capable of being clamped and be able to withstand the upsetting pressure without distortion. Spot welding tips with W alloy inserts have about 5 times the life of Cu tips. TEJ (11c)

Estimated Oxy-Acetylene Pipe Welding Costs. John H. Zink. *Welding,* Vol. 3, Feb. 1932, pages 111-113.

Reprinted from Nov. issue of the Official Bulletin of the Heating and Piping Contractors National Association. The author offers cost figures obtained in his own welding practice as a guide in computing pipe welding costs. TEJ (11c)

Making 400 Welded Jigs per Month. J. R. Weaver (Westinghouse Elec. & Mfg. Co.). *Machinery,* Vol. 38, Oct. 1931, pages 108-109.

General discussion of jig construction by arc-welding. This method is faster and cheaper than using a pattern and casting. In many cases, the jig can be welded for the same time and cost as for the making of the pattern alone. RHP (11c)

Machine Tool Frames Produced by Welding. J. R. Weaver (Westinghouse Elec. & Mfg. Co.). *Machinery,* Vol. 38, Nov. 1931, pages 171-172.

General discussion. Welding seems quicker and cheaper unless a large number of pieces are to be made, in which case a pattern and the use of cast iron may be just as good. RHP (11c)

Importance of Standardization in the Welding Industry. C. G. Watson. *Welding,* Vol. 3, Jan. 1932, pages 30-34.

The author offers some helpful suggestions as to how standardization can be brought about in the welding industry. TEJ (11c)

Welding Monel Metal. W. E. Warner. *Canadian Machinery,* Vol. 42, Dec. 1931, page 39.

Monel metal can be successfully welded by either oxy-acetylene, metallic arc or spot welding, provided proper precautions are observed. The oxy-acetylene flame should be reducing. An alcoholic solution of boric acid may be used as a flux. Where metallic arc welding is adopted, it is necessary to make the work the negative pole and to use a flux coated electrode. Monel metal can be welded on most spot welding machines now in use. WAT (11c)

Recent Developments in the Welding of Overland Pipe Lines. H. E. Rockefeller. *Paper read before the 32nd Annual Convention, International Acetylene Association,* Chicago, Nov. 1931, 4 pages.

The recent developments of welding long pipe lines, 70% of which was done by oxy-acetylene, and possible uses for pipe lines for other materials than gas or oil are discussed. The methods of welding and the influence of good welders are reviewed. Ha (11c)

The Application of the Theory of the Electric Arc on Welding—The Importance of Burning Depth in Electric Welding. (Die Anwendung der Lichtbogentheorie auf die Schweissung-Die Bedeutung der Einbrandtiefe beim Lichtbogenschweissen.) E. Rosenberg, W. Fink & E. Schwarz. *Zeitschrift Verein deutscher Ingenieure,* Vol. 75, July 4, 1931, pages 881-884.

Controversial remarks are exchanged in which the influence of the characteristic of the welding machine and automatic or manual welding on the welded seam is discussed with reference to previous articles. Ha (11c)

From the Stationary to the Movable Equipment for Spot Welding. (Von der stationaren zu freibeweglichen Punktschweisseinrichtung.) K. Ruppin. *Schweizerische Technische Zeitschrift,* Vol. 29, Feb. 11, 1932, pages 80-82.

The electric resistance spot welding offers difficulties when the parts to be welded are bulky. By developing a new apparatus, a so-called double spot welding apparatus, these difficulties are eliminated. This method uses 2 electrodes which are put side by side but not opposite as in the former methods. This is an essential improvement, the method is easier to handle and also cheaper. The new method is illustrated by a few practical examples. GN (11c)

Modern Fusion Welding and Cutting Equipment and Materials. H. Reininger. *Engineering Progress,* Vol. 12, Dec. 1931, pages 276-282.

Reviews the more important new processes and equipment used in welding. Metallurgical aspects of the subject are dealt with very briefly. RHP (11c)

ECONOMIC (16)

Silver, Its Application to Our Present Problem. RÉNÉ LÉON. *Mining & Metallurgical Society of America, Bulletin* No. 223, Vol. 25, Jan. 1932, pages 6-12.

A political-economical discussion of the question how the present financial depression and confusion the world over can be alleviated and the return of normal times be hastened leads the author to advocate the coining of Ag of high Ag content under an agreement between all governments and a Ag production tax as principal means to restore equilibrium in money exchange. Ha (16)

Geology and Economics of Tin Mining in Cornwall, England. ERNEST R. LILLEY (New York University and John Simon Guggenheim Foundation Fellow). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 479, 17 pages.

Cornwall is a very old mining section, and really modern methods of mining and concentrating have never been applied. Abundant ore is still present. A critical review of the operation of the various properties. JLG (16)

The Economic Significance of Specifications from the Standpoint of a User of Steel. P. PARKE. *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 2, 1931, pages 963-966.

See abstract of preprint. *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 47. HWG (16)

Some Causes of Increased Sales in Welded Piping. A. L. BYFIELD. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 4 pages.

A discussion of the points which have contributed to greatly increase the use of entirely or partially welded piping. Ha (16)

Why Not an International Silver Conference? CHAS. A. MITKE. *Mining Congress Journal*, Vol. 17, Dec. 1931, pages 656-59.

Excellent discussion of this subject. The quickest and most effective remedy for the present disastrous fall in prices is offered through raising the price of Ag and its restoration to a place in the world's monetary system. The action of governments has produced the present results, and it is by governments that the situation must be remedied. A table of comparative importance of Ag and other commodities is given. DTR (16)

The Restoration of Silver. TASKER L. ODDIE. *Mining Congress Journal*, Vol. 17, Dec. 1931, pages 654-655, 659.

Restoration of value of Ag to the extent, at least that it enjoyed in days before World War, would afford a currency in which people can have confidence because of inherent intrinsic value and relief afforded the growing burden on Au. It requires no great study to restore the value of Ag to its pre-war status. The step is easily taken, if the will to take it exists. DTR(16)

Tin in 1930. CHARLES WHITE MERRILL. *Mineral Resources of the United States*, 1930, United States Bureau of Mines, Part 1, Jan. 15, 1932, pages 355 to 383.

Imports of Sn in 1930 exceeded $60,000,000 in value, and domestic mine production was worth only $10,500 (15 long tons). Of this 13.1 tons came from Alaska (34.5 tons in 1929) and the remainder from North Carolina and South Dakota. In 1930, 23,393 long tons of secondary Sn were recovered, a decline of 24% from 1929. This secondary Sn is 29% of the virgin Sn imported in 1930. Imports of 80,734 long tons (87,127 in 1929) were more than any previous year except 1929, but less in value than any year since 1922. Of this British Malaya was the source of 69%, the United Kingdom 15%, the Netherlands 9%, Hong Kong 6% (total 99%) and Australia, Netherland East Indies, Germany, China, Canada and Haiti the remainder. World production of Sn in 1930 (174,000 long tons) decreased 9% from 1929. AHE (16)

Using Point System to Compute Molding Piece Rates. W. J. MCNEILL. *Foundry*, Vol. 59, Nov. 1, 1931, pages 59, 73.

Abstract of a paper read before the American Foundrymen's Association in Chicago. See *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 76. VSP (16)

The Mineral Position of the British Empire. CHARLES CAMSELL (Deputy Minister of Mines, Canada). *Canadian Mining & Metallurgical Bulletin* No. 238, Feb. 1932, pages 15-29.

The British Empire has large surpluses of most minerals. Canada has surpluses in Cu, Pb, Ni, Zn, asbestos, gypsum, mica, pyrite and talc only. AHE (16)

Silver, Copper, Lead and Zinc in the Central States in 1930. J. P. DUNLOP & H. M. MEYER. *Mineral Resources of the United States*, 1930, *United States Bureau of Mines*, Part 1, Dec. 24, 1931, pages 209-242.

The total value of the mine production of Ag, Cu, Pb and Zn in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma and Wisconsin in 1930 was $68,313,236 ($42,666,007 less than in 1929). Ag production, chiefly as a by-product from other metals, was 179,827 oz. worth $69,234 (206,133 oz. and $109,869 in 1929). Cu output was 169,558,013 lb. valued at $22,042,542, largely from Michigan (186,404,458 lb. and $32,807,184 in 1929). Pb shipments decreased 13.3% in quantity to 237,533 short tons and 31.2% in value to $23,753,300. Zinc output of 233,835 short tons worth $22,448,160 decreased from 329,935 tons and $43,551,420 in 1929. 9 references. AHE (16)

Gold, Silver, and Lead in South Dakota in 1929. CHAS. W. HENDERSON. *Mineral Resources of the United States*, 1929, *United States Bureau of Mines*, Part 1, 1931, pages 265-270.

In 1929, S. D. produced Au, Ag and Pb worth $6,595,001, a decrease of less than ½% from 1928. Au output was 316,836.85 oz., $6,549,599 in value. Ag production was 85,182 oz. worth $45,402. 7 references. AHE (16)

The Development of Gold Mining in South African Union. (Die Bergwirtschaftliche Entwicklung des Goldbergbaus der Südafrikanschen Union.) R. KRAHMANN. *Zeitschrift für Berg-Hütten- und Salinenwesen*, Vol. 79, 1931, pages B139-166.

An historical account of the development of the industry. Statistical data show its growth from 1884-1929. The mineralogical and geological nature of the deposits, technical and human power, production of each mine and the possible future and the industry are discussed. JGT (16)

PLANTS & LABORATORIES (17)

The Plant and Laboratories of the Trubia Fabrica Nacional in Spain. A. G. SOTO. *Metals & Alloys*, Vol. 2, Dec. 1931, pages 358-359.

The facilities of Fabrica Nacional for the production of steel and ordnance material is described and illustrated by photographs. WLC (17)

Special Equipment Designed for Heat Treating Tubular Axles. I. W. SPRINK. *Steel*, Vol. 89, Aug. 6, 1931, pages 39-40.

Describes the city-gas fired furnaces and auxiliary equipment. Ha (17)

New Research Building Completed. F. B. PLETCHER. *Steel*, Vol. 89, Dec. 21, 1931, pages 31-33.

The new building for the engineering and research departments of the A. O. Smith Corporation, Milwaukee, is described. Ha (17)

Modern Production Methods for Welded Side Seam Drums. E. B. PEET & W. P. BLAKE. *Metal Stampings*, Vol. 4, Oct. 1931, pages 797-800, 806; Nov. 1931, pages 903-905, 914.

Description of the method and equipment of a plant making 3000 55-gal. tanks/10-hr. day. Ha (17)

The Midvale Research Laboratory. RICHARD RIMBACH. *Metals & Alloys*, Vol. 2, Nov. 1931, pages 288-289.

The equipment of this steel maker's laboratories is described with illustrations showing the original building and present home, some of the equipment and the personnel. WLC (17)

Forming and Heat Treating Radio Parts on Production Basis. W. T. FULTON. *Steel*, Vol. 88, Mar. 12, 1931, pages 35-37.

The process and equipment of the Stromberg-Carlson Telephone Company is described. Ha (17)

Aluminum Pots and Kettles are Foundry Products. JAS. BREAKEY. *Canadian Foundryman*, Vol. 22, Sept. 1931, pages 7-9.

Description, accompanied by 4 photographs, of the aluminum foundry of the Super Health Aluminum Company, McGill Street, Toronto. OWE (17)

Building the Hamilton Watch. I. HOWARD CAMPBELL. *Modern Machine Shop*, Vol. 4, Jan. 1932, pages 7-12.

Manufacturing methods, tools and testing in the production of time pieces are described in detail. Ha (17)

The National Physical Laboratory. *Gas Journal*, Vol. 194, June 10, 1931, pages 756-757.

Describes the laboratory, its purposes, and the high temperature work which is being done. MAB (17)

British Non Ferrous Metals Research Association. *Metal Industry*, London, Vol. 38, June 12, 1931, pages 601-605.

A detailed description is given of the new laboratory of the Association. PRK (17)

Special Research Equipment and How it is Used. *Iron Age*, Vol. 127, June 4, 1931, pages 1811-1815.

Describes special equipment used in studying the properties of metals and determining how they can be applied to best advantage by the American Rolling Mill Co. In the metallographic laboratory, the equipment consists of 2 large inverted metallographic microscopes for examination of metals at magnification of 50-3000 diameters; one inverted microscope with a magnification of from 50-1500 diameters; one micro tessar for photographing samples at low magnification and a binocular microscope with magnification range of from 10-85 diameters for examination of features. Amount of H, O and N existing as impurities in metal is determined by vacuum fusion apparatus. Of universal interest is the method of calibrating pyrometers. In the investigation of vitreous enameling of sheet metal, the equipment consists of dipping pans, smelting furnaces, raw material jars for grinding screens and pans. The magnetic testing laboratory contains a Fahy simplex permeameter and control equipment for measuring permeability and hysteresis loss of bar or sheet samples. VSP (17)

A Model Heat Treat for Precision Grinder Plant. *Metal Progress*, Vol. 18, Dec. 1930, pages 60-63.

Describes the heat treating plant of Heald Machine Co., Worcester, Mass. WLC (17)

From Clocks to Brass Sheet, Rod, and Wire. *Metal Industry*, N. Y., Vol. 29, May 1931, pages 191-193.

A brief description of the Bristol Brass Corporation plant at Bristol, Conn. PRK (17)

Zinc Recovery and Fertiliser Plants in British Columbia. *Engineer*, Vol. 152, July 17, 1921, pages 60-61.

Describes units of the Consolidated Mining and Smelting Company of Canada recently put into operation at Trail, British Columbia. The plants consist of a slag re-treatment plant for the recovery of Zn and a zinc oxide leaching plant for the treatment of the recovered Zn. Includes photographic illustrations of the plant. LFM (17)

Oil Well Drill Tools Must Stand Hard Usage. J. B. NEALEY (American Gas Association). *Iron Age*, Vol. 128, Oct. 29, 1931, pages 1116-1118.

Description of the plant of the Guiberson Corp., Dallas, makers of oil well supplies, including disk bits, tubing, catchers, swabs, etc. There are 13 gas furnaces of the periodic type, all alike except that 11 are semi-muffle and 2 are full-muffle. More than 200,000 different parts are produced. Principal item is a disk for rotary drilling. S.A.E. Ni-Cr steel No. 3250 is used. Cutters are made from S.A.E. Ni-Mo steel No. 4615. Reamer cutters are made of Cr-V steel with 0.70% C; 3.50% Ni; 1.25% Cr; 0.18% V. Cylinder heads for Diesel aircraft engines are made of Ni-Cr-Mo-V steel with a composition of 3.50% Ni; 1.25% Cr; 0.28% Mo; 0.18% V; 0.60-0.80% Mn. VSP (17)

Heat Treating Oil Well Drill Tools. J. B. NEALEY (American Gas Association). *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1134-1135.

Same as article in *Iron Age*, Vol. 128, Oct. 29, 1931, pages 1116-1118. See abstract above. MS (17)

Dosco Establishes Canadian Record for Steel Ingot Casting. *Iron & Steel of Canada*, Vol. 14, Nov. 1931, page 172.

Brief description of what are believed to be the largest steel ingots produced in Canada and of forgings which were produced from the same. OWE (17)

Canadian Railroad Builds New Foundry. *Foundry,* Vol. 60, Jan. 1, 1932, pages 32-35.
Describes the new gray iron foundry at Point St. Charles, Montreal, of the Canadian National Railways. VSP (17)

Modern Heat Treating in Truck Manufacture. FRED C. SMITH (International Harvester Co.). *Metal Progress,* Vol. 20, Dec. 1931, pages 45-52.
The author describes the modern heat treating plant of his firm consisting of gas and electrically heated furnaces with modern control equipment. The arrangement is designed to facilitate the passage of work efficiently through the department and provide for the comfort of the workmen. Facilities for recovery and mixing old and new carburizing compound with minimum of dirt and discomfort to workmen are described. WLC (17)

Radial Engines Produced in Modern Plant. H. R. SIMONDS. *Steel,* Vol. 88, Feb. 5, 1931, pages 43-46, 50.
A description of the airplane engine manufacturing plant of the Pratt and Whitney Aircraft Co. in East Hartford, Conn., with descriptions of some of the special procedures involved in the accurate machining and finishing of various engine parts. JN (17)

A New X-ray-Metallographic Laboratory. (Un nouveau Laboratoire de Radiometallographie.) J. J. TRILLAT. *Revue d'Aluminium,* Vol. 8, Mar.-Apr. 1931, pages 1357-1363.
Several examples are described to show the advantage of X-ray testing for metallurgical purposes; the equipment of laboratory is described which has been installed in Bourget by 3 French companies to investigate Al, Cu and steels. Ha (17)

Close Control Cuts Losses in Piston Ring Castings. FRANK G. STEINEBACH. *Foundry,* Vol. 59, Dec. 1, 1931, pages 40-44, 46.
Describes the plant of the Perfect Circle Co., located at New Castle, Ind. Foundry losses, in manufacturing gray iron castings, were less than 5% of the castings produced during the first 6 mos. of 1931. VSP (17)

Commercial Heat-Treating Plant Has 16 Furnaces. HARRY TURNER (Ohio Heat Treating Co.). *Iron Age,* Vol. 128, Nov. 12, 1931, pages 1238-1240.
Description of the plant of the Ohio Heat Treating Co., Dayton, Ohio. 8 oven-type furnaces are arranged in 2 rows, with monitor roof overhead for localizing and removing excess heat. Furnaces range from 12" x 24" x 9" high speed to 36" x 84" x 24" carburizing furnaces. A 24-hr. service is maintained. VSP (17)

Heat Treating Department of a Modern Manufacturing Plant. J. B. NEALEY. *Western Machinery World,* Vol. 22, Dec. 1931, pages 568-570.
Equipment and methods used at the Lincoln automobile factory exemplify the most modern engineering achievements in this field. The furnaces and temperature controllers are described and illustrated. WAT (17)

Nickel Silver in Rod and Wire. RICH. E. BROWN. *Wire & Wire Products,* Vol. 7, Feb. 1932, pages 41-43, 58-59, 61-63.
An outline of the history and the development of nickel-silver is given with a description of present day methods of rod and wire production at the plant of the Seymour Manufacture Co., Seymour, Conn. The article is amply illustrated. Ha (17)

Makes Marine Castings in Panama Canal Foundry. C. A. MCILVAINE. *Foundry,* Vol. 59, May 15, 1931, pages 91-92.
Description of the equipment of the Balboa shops at Balboa, C. Z. VSP (17)

The Metal Mine—Wire Rope Problems. A. J. MORGAN (John A. Roeblings' Sons Company). *Mining Congress Journal,* Vol. 17, Mar. 1931, pages 155-159, 163.
Detailed description of fabrication of wire rope in Roeblings' plant, Trenton, N. J. Wire rope consists of iron or steel wires, laid into strands, and these strands are closed around a hemp wire-rope center. The steel is made in an open-hearth furnace; the charge consists of pig iron, iron ore, and scrap. The name "crucible cast steel," given to one grade of wire rope is erroneous, for no steel for wire rope is made in a crucible. Acid open-hearth steel is the best material; "acid" refers to the furnace lining and process only. Process from the initial casting into ingots and completely through the wire drawing is given. Discussion of factors governing wire rope service, life, costs, wire rope attachments, lubrication, and the proper time to remove ropes from service is pointed out along with various illustrations. DTR (17)

Advance of Electrolytic Copper Production with Special Reference to the New Copper Electrolysis of the Zinnwerke Wilhelmsburg. (Die neuere Entwicklung der elektrolytischen Kupfergewinnung unter besonderer Berücksichtigung der neuen Kupferelektrolyse der Zinnwerke Wilhelmsburg, G. m. b. H.) G. EGER. *Die Metallbörse,* Vol. 20, Sept. 15, 1931, page 1738.
The new installation at Wilhelmsburg is described: capacity = 50 tons of electrolytic Cu, current density = 10,000 amps. Number of tanks = 220. Paper before the Deutsche Gesellschaft für Berg- und Hüttenleute, 1931. EF (17)

The New Lead Refinery and Its Operation at the Bunker Hill Smelter. A. F. BEASLEY, J. B. SCHUETTENHELM & J. W. JOHNSON (Bunker Hill & Sullivan Smelter). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 11 pages.
Describes the plant completed about March, 1930. It is equipped with 6 105-ton drossing kettles, 2 350-ton softening furnaces, 3 225-ton desilverizing kettles, 2 250-ton refined-lead storage kettles, 1 75-ton residue furnace and a Newman-type casting wheel. The particular steps in the refining operation are described. The man-hour output per day of Pb and Ag is 4.6 tons and 550 oz. respectively. JLG (17)

Produces Engines for Automotive Marine and Industrial Purposes. EDWIN BREMER. *Foundry,* Vol. 59, Nov. 1, 1931, pages 40-43; Nov. 15, 1931, pages 31-34.
A series of 2 articles describing the methods employed in the foundry of the Buda Co., Harvey, Ill., makers of 4 and 6 cylinder gasoline engines. The first article deals with the casting of motor blocks; while the second is concerned with the production of flywheels, flywheel housings, gear case covers and castings for Diesel engines. VSP (17)

Castings Play Important Part in Lighting Fixtures. NORMAN F. HINDLE. *Foundry,* Vol. 59, Dec. 15, 1931, pages 18-21.
Description of the plant and designing department of the Kayline Co., Cleveland. Types of patterns depend on the ease of working the design in the material required. Metals used include Ni, Au, brass, bronze, Al and Richelieu bronze. Few cores are used because the patterns are designed to leave their own green sand molds. VSP (17)

Non-Metallic Minerals and Industry. W. M. GOODWIN. *Iron and Steel of Canada,* Vol. 14, Nov. 1931, pages 167-169, 171; Dec. 1931, page 184.
A description of various plants located at Shawinigan Falls, Quebec, which is one of the most important and most rapidly growing electro-metallurgical centers of Canada. Reference is made, among others, to the plant of the Northern Aluminum Company and to the Arvida works of the company where electrical transmission cables of aluminum are manufactured. The works of Shawinigan Stainless Steel and Alloys, manufacturers of Duriron, are also mentioned. OWE (17)

MACHINERY & SUPPLIES (18)

Blast Furnace Blower. *Engineering Progress,* Vol. 13, Jan. 1932, page 17.
Illustrates and very briefly describes a blower capable of delivering 64,000 ft.^{3} of air per minute. RHP (18)

Electrohydraulic Operator has many Applications. *Steel,* Vol. 90, Feb. 22, 1932, page 26.
The apparatus is used for a smooth straight-line thrust in one direction for a definite distance and consists of a piston providing the thrust actuated by oil pressure which is supplied by a small oil pump impeller. Its use with a toggle drawing press, brakes, wire strander and in a welding installation is illustrated; it is operated by push-buttons. Ha (18)

BIBLIOGRAPHIES (19)

A Résumé of Published data on Steel Foundry Practice. A. H. DIERKER & H. B. KINNEAR. *Engineering Experiment Station, Ohio State University, Circular* No. 25, 1931, 56 pages, price $1.00.
Fairly extended abstracts of 109 selected articles bearing on the general subject of "factors affecting the surface of steel castings." These are separated into a group dealing with the metal and the furnace practice, one dealing with molding and core sand, and one with general foundry practice. Shrinkage is given particular attention. The relatively small number of abstracts of articles published in other languages than English appear to be taken from other abstracts rather than from the originals. Those of articles in English are chiefly original and more complete than most other published abstracts. The available German information appears to be inadequately covered. The compilation is a useful, but not a complete, résumé of the subject. It was prepared for a committee of the American Foundrymen's Association. HWG (19)

Chromium Plating Literature. L. H. DECKE. *Brass World,* Vol. 28, Feb. 1932, pages 23-24.
Abstracts of articles and reviews of books on this subject from 1930 to the present time. This installment covers adhesion, with later ones to include "applications," "nickel sub-coats," "passivity," and "general." WHB (19)

Morphology and Occurrence of Pyrite. (Pyritformen und Fundorte.) L. TOKODY & K. ZIMANYI. *Zeitschrift für Kristallographie,* Vol. 80, Oct. 1931, pages 255-348.
The crystallographic occurrence and origin of pyrites is exhaustively treated. 706 references. EF (19)

The Radio-active Constants up to 1930. (Die radioaktiven Konstanten nach dem Stand von 1930.) *Physikalische Zeitschrift,* Vol. 32, Aug. 1, 1931, pages 569-581.
Report of the International Standard Committee compiling all data available on the radio active constants up to 1930. Includes several bibliographies. EF (19)

Bibliography of Bibliographies on Chemistry and Chemical Technology. Compiled by CLARENCE J. WEST & D. D. BEROLZHEIMER. *Bulletin 86, National Research Council,* 1932. Paper, 6½ x 9¾, 150 pages. Price $1.50.
Bulletin 86 is the Second Supplement to the Bibliography of Bibliographies on Chemistry and Chemical Technology covering the period 1929-1931. The original Bulletin (No. 50) covered the period 1900-1924 and contained about 10,000 bibliographies classified under 2400 headings. The First Supplement (No. 71) covered the period 1924-1928 and contained about 4000 bibliographies under 1050 headings. The Second Supplement (No. 86) covers the period 1929-1931 and contains approximately 3300 bibliographies under 950 headings.
As the title indicates, the work (as in the case of Bulletins Nos. 50 and 71) is a compilation of bibliographies published as separates, or at the end of books or magazine articles, or as footnotes to the same, on the numerous aspects of pure and applied chemistry. Each entry gives name of author or compiler, title, and place of publication. The majority of the entries state the number of references, thus giving an indication of the completeness of the particular bibliography. The entries are classified under the proper subject-headings, alphabetically arranged. The duplication of individual entries has been largely avoided by the liberal use of cross references. (19)-B-

International Scientific and Political Bibliography. (Bibliotecn Scientifico-Politecnica Internazionale). Hoepli, Milan, 1932. Paper 4¼ x 8½ in., 528 pages. Price 10 Lire.
The book is a compilation of the more important Italian and foreign books published from 1926-1931. It is arranged by subject, with excellent cross references and an author index at the end. The majority of the titles are annotated and the date of publication and collation information is included. Although it is not entirely complete, the information it contains is accurate and worthwhile to have. Forty-eight references are given under metallography and metallurgy. A 10% discount is allowed from the list price and 20% on some of the English works. The volume would be worth its price in most libraries. T. R. Reinberg (19)-B-

MISCELLANEOUS (20)

Shipbuilding and its Relation to the Steel Industry. H. Gerrish Smith. *Engineering*, Vol. 131, June 19, 1931, pages 801-802.

Paper read before the American Iron & Steel Institute, New York, May 1931. See *Metals & Alloys*, Vol. 2, Oct. 1931, page 218. LFM (20)

Plasticity, A Mechanics of the Plastic State of Matter. (Revised and enlarged from the first German edition.) A. Nadai, assisted by A. M. Wahl. *Engineering Societies Monograph.* McGraw-Hill Book Co., Inc., New York, 1931. Cloth, 6 x 9¼ inches, 349 pages. Price $5.00.

The English translation of the German is skillfully rendered and in enlarging the edition, some of the most recent information pertaining to the plastic state of matter is included.

In presenting the subject-matter of the book, Dr. Nadai has made two broad divisions. The major study and the most interesting from the view point of the engineer is devoted to the plastic state of matter with special reference to metals and to mechanical engineering problems. In the latter part of the book some applications of the mechanics of the plastic state of matter to geology and geophysics are presented.

The author introduces the concept of plasticity without actually defining the term and its limitations. He then proceeds to give a descriptive analysis of such points of interest as elastic and permanent deformation, and the mechanism of plastic deformation in the grain structure. Though this analysis is of special interest to the metallurgist, it is covered somewhat hurriedly. From this point, the book becomes a highly mathematical treatise and to those familiar with theoretical and applied mechanics, it is a valuable contribution. This is especially true of the chapters dealing with stress, strain, theories of strength and related tests and tension. Some fine photographs of strain or flow figures in steel, paraffin, marble and copper specimens under tensile, compressive or torsional loading illustrate the stress distribution under the conditions cited.

A few observations relative to the plastic deformation near the regions of contact of materials deformed by indentations in various ways are given in a chapter on hardness. It is recognized that various metals behave very differently when an indentation is made by a punch but nothing is offered as a possible cause for the behavior.

There are some very interesting figures to illustrate the similarity of the slip lines produced by a punch in steel and the slip lines determined by photo elastic tests occurring in celluloid plates under a rigid punch.

On the application of the mechanics of the plastic state of matter to geology and geophysics, Dr. Nadai takes one into a field quite apart from that of metals. Here pressures of enormous magnitude exist that play an important role in the observed behavior of rock movements. Such subjects as the pressure in the earth's interior, mountain building, the origin of rock-salt domes, the weight of the continents and the traces of motion in the structure of rocks are treated in an interesting way.

To the engineer interested in applied mechanics, the book is highly valuable. To the metallurgist who is seeking for new knowledge on the physics of crystals as a guide in looking for the mechanism of the plastic behavior observed in metals, and in predicting new properties the book will undoubtedly be somewhat disappointing. C. H. Lorig (20)-B-

The Phenomenon of Slip in Plastic Materials. A. Nadai. *Proceedings American Society for Testing Materials*, Vol. 31, Pt. 2, 1931, pages 11-46.

See abstract of preprint. *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 49. HWG (20)

Plastic Deformation and State of Deformation. (Verformung und verformter Zustand.) M. Polanyi. *Die Metallbörse*, Vol. 21, Dec. 2, 1931, page 2075.

Extract of a lecture in the Haus der Technik, Essen, Nov. 1931. Compares the behavior of crystalline and amorphous materials with reference to their plasticity. The difference becomes most obvious at extremely low temperatures where crystals do still exhibit plasticity. EF (20)

Radium in Rocks. C. S. Piggot & H. E. Merwin. *American Journal of Science*, Vol. 23, Jan. 1932, pages 49-56.

2 granites of high radium content were separated into their component minerals and these examined in detail for radium. The radium is associated much more with the micas, weight for weight, than with the other components of the rock. Why this should be is not evident. Hot water removes from most powdered specimens some of the emanation in equilibrium with the radium present but apparently does not affect the radium, and probably not the parent uranium. It did not affect the radioactivity of one biotite at all. The radioactivity of leached samples was completely restored after 30 days. WAT (20)

On the Action of Iron and Nickel on (Fused) Alkali Metal Salts. (Action du fer et du nickel sur les sels alcalies.) L. Hackspill & H. J. Pinck. *Bulletin de la société chimiques de France*, Vol. 49, Jan. 1931, pages 54-70.

The alkali metals are formed by heating the sulphates, arsenates, phosphates, borates, and aluminates with Fe in a vacuum at or above the melting point of the salt. Li is obtained, however, only from the oxide or silicate under these conditions. Ni displaces the alkali metals only from their hydroxides or sulphides. WHB (20)

Recent Testing Results on the Plastic Behavior of Metals. (Neuere Versuchsergebnisse über das plastische Verhalten der Metalle.) K. Hohenemser. *Zeitschrift für angewandte Mathematik und Mechanik*, Vol. 11, Dec. 1931, pages 423-425.

The speaker at the 7. Deutscher Physiker- und Mathematikertag, Bad Elster, Sept. 1931, summarizes the investigations and mathematical interpretations of the Institut für angewandte Mathematik der Universität Göttingen regarding the behavior of metals during plastic deformation. In more recent theoretical derivations the strain hardening effect is taken into account. Further publications are under way. EF (20)

The Diffusion of Cathodically Developed Hydrogen Through Iron. (Die Diffusion des kathodisch entwickelten Wasserstoffs durch Eisen.) A. H. W. Aten & P. C. Blokker. *Recueil Travaux Chimiques Pays-Bas*, Vol. 50, July 15, 1931, pages 943-950.

Poisons greatly accelerate the diffusion through the cathode and increase its velocity. The effect of $HgCl_2$ was studied in electrolytes of H_2SO_4 and NaOH, both 0.1 *N*. A small quantity of $HgCl_2$ (1-2 cc. 0.01 *M*) markedly increased the diffusion velocity. A large amount slightly lowered it. The latter effect was more marked the higher the current density. Curves of cathode potential showed a parallelism to those of diffusion velocity, the more negative the potential the greater the diffusion velocity. Diffusion through Ni-Fe and Cr-Fe in an electrolyte of 0.1 *N* H_2SO_4, with and without As_2O_3 as a poison, is measured and the results are given. Equations for the diffusion velocity and potential are developed and discussed. No satisfactory explanation is given of the interdependence of current density potential and diffusion velocity. Ha (20)

Car Scrapping by the Line Production Method. T. M. Hamer. *Paper read before the 32nd Annual Convention, International Acetylene Association*, Chicago, Nov. 1931, 5 pages.

Discussion whether scrapping is done better by a railway company itself or to have it done by outsiders. Ha (20)

Plastic Deformation and Its Underlying Law. (Plastizierung und ihre Gesetzmässigkeit.) O. Manfred. *Zeitschrift für physikalische Chemie*, Sect. B, Vol. 15, Jan. 1932, pages 383-387.

The author summarizes his paper on "Plastizierung" (i.e. 'the work, or procedure which carries a solid material by permanent deformation above the limit of elasticity into the range of flowing or plastic deformation") as follows: Between the degree of plastification ("Plastizierungsgrad") and physical properties of any material a functional relationship exists insofar as with increasing degrees of plastic deformation the physical properties are improving independent from the structure of the material. A table is included in the paper showing the strain hardening effect in non-metallic materials, in Cu and wrought Fe. Stress is laid on tests of Reinkober (*Physikalische Zeitschrift*, Vol. 32, Mar. 15, 1931, page 243) on glass and quartz clearly proving that, irrespective of the crystalline or colloid-plastic nature of the testing material, a strain hardening effect or improvement of physical properties takes place due to stretching. EF (20)

The Oxidation of Phosphorus Vapor at Low Pressures in Presence of Platinum and Tungsten. H. W. Melville & E. B. Ludlam. *Proceedings Royal Society*, Vol. 135A, Mar. 1932, pages 315-333.

The actions of hot filaments of Pt and W on mixtures of P vapor and O at pressures smaller than the lower explosion limit has been investigated in some detail. With Pt it was found that the reaction rate is conveniently measurable with the filament at a temperature of about 200° C. The reaction velocity is directly proportional to the O pressure. Argon is without influence on the rate of the reaction. No glow is emitted during the oxidation. The reaction therefore occurs at the Pt surface. With the W filament at 500° C. the rate of the reaction can be conveniently measured. This rate is proportional to the pressure of the O and the P. A green glow accompanies the process of the reaction. The reaction thus probably starts on the W side, is propagated through the gas phase and finally ends on the wall of the reaction tube. Au, Ag, and Mo behave similarly to W, but have not been studied in detail. WAT (20)

Making Expansion Fits with Liquid Air. E. V. David & W. S. Farr (Air Reduction Sales Co.). *Machinery*, Vol. 38, Nov. 1931, pages 189-192.

Liquid air is used in cooling the inner member so it will contract. It is then inserted in the outer member and expands to fit. This method is useful when the inner member is light compared to the outer member or when heating will warp or crack the part. Liquid air varying from 40% liquid oxygen and 60% liquid nitrogen to 60% liquid oxygen and 40% liquid nitrogen may be used. Its boiling point may be taken as —310° F. 200 B.t.u. are required to evaporate one liter of liquid air. The following table gives data for determining approximate amount of liquid air evaporated in cooling metals.

Kind of Metal	Weight of Metal/in.3 lbs.	Heat given off/lb. of metal cooled B.t.u.	Weight of metal cooled /liter of liquid air evaporated lbs.	Amount of liquid air evaporated /lb. of metal fully cooled liters
Aluminum	0.098	71.4	2.80	0.357
Brass	0.310	33.1	6.04	0.166
Bronze	0.323	34.2	5.85	0.171
Cast Iron	0.260	39.5	5.06	0.198
Copper	0.322	29.7	6.73	0.148
Monel metal	0.318	34.2	5.85	0.171
Nickel	0.317	34.6	5.78	0.173
Steel	0.285	34.6	5.78	0.173

Also gives tables showing linear contraction per in. from 70° F. to —310° F. for these metals. Linear expansion when heated from 70° F. to 212° F. for the same metals. Table of allowances and tolerances for sliding fits. Shipping of liquid air. Estimation of evaporation in shipping and handling. Lists precautions and gives instructions for handling liquid air for expansion fits. See also *Metals & Alloys*, Vol. 3, Mar. 1932, page MA 74. RHP (20)

The Dangers in the Production of Aluminum Powder and Their Prevention. (Die Gefahren bei der Herstellung von Aluminiumpulver und ihre Verhütung.) Bethke. *Feuerschutz*, Vol. 11, Apr. 1931, pages 65-66.

The causes of ignition can be: open flames, electric sparks, hot wires, impact, friction, hot bearings, self-ignition by oxidation. The flames are best extinguished by airtight covering with sand. Ha (20)

FOUNDRY PRACTICE & APPLIANCES (22)

Methods for Testing of Molding Sands. (Les methodes actuelles d'essai et de controle des sables de moulage.) A. DELEUSE. *Revue de Metallurgie,* Vol. 28, May 1931, pages 281-283. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 22. JDG (22)

Bronze Pressure Castings. J. E. CROWN. *Transaction & Bulletin American Foundrymen's Association,* Vol. 2, Nov. 1931, pages 496-505.
Factors involved in the successful production of bronze castings for pressure service are: selection of alloys, design of pattern, method of molding, types of heads and gates. The alloy contains 87.25% Cu, 9% Sn, 3% Zn and 0.75% Ni. Average pouring temperatures are 1950° F. See also *Metals & Alloys,* Vol. 2, Dec. 1931, page 321. CHL (22)

Evolution in the Foundry; Molding in Snap-Molds. (Evolution de la Fonderie; le Moulage par Mottes.) M. CONSTANT. *Revue de Fonderie Moderne,* Vol. 26, Mar. 10, 1932, pages 84-87; Apr. 1932, pages 138-140.
A method for molding pieces of a form too complicated for machine molding is described whereby proper sectioning of the mold is paid particular attention in order to save time in molding if a larger number of pieces is to be cast. The process is illustrated by an example; parts of the mold can be made by machine. Ha (22)

Mold-Blacking. (Formschwärze.) E. FEIL. *Die Giesserei,* Vol. 19, Feb. 5, 1932, pages 41-46.
A testing method is described for testing the gas permeability and strength of the blacking which is used in molds to give the castings a smooth surface. The tests showed that the blacking has to be adapted to the kind of casting; very massive castings require a blacking of higher strength. Also the thickness of the coating is of importance for the permeability of gas. Ha (22)

Arrangement of the Pattern and Making of the Mold of a Grate Bar of a Locomotive of Special Construction. (Modelleinrichtung und Herstellung der Form eines Lokomotivroststabes besonderer Konstruktion.) K. GROCHOLL. *Die Giesserei,* Vol. 19, Feb. 19, 1932, pages 71-72.
Description of the pattern and procedure of molding. Ha (22)

European Iron Founders Use Rotary Furnace. Correspondence from F. GIOLITTI. *Metal Progress,* Vol. 21, Apr. 1932, pages 72-73.
European foundrymen are turning to revolving furnaces of the Brackelsberg type for the production of high grade alloy cast Fe. Revolving furnaces are frequently duplexed with the cupola. A Brackelsberg furnace of 1½ T. capacity can supply 3200-3500 lbs. of Fe of predetermined composition at 3000° F. at 40 minute intervals using sluggish cupola iron at 2300° F. WLC (22)

A Study of Molding Sands. (Etude des Sables de Moulage.) L. GASQUARD. *Revue de Fonderie Moderne,* Vol. 26, Mar. 25, 1932, pages 95-104.
Testing methods and determinations of the structure of sand grains are described, the advisability of recuperation and regeneration of used sands is discussed. An addition of kaolin improves a molding sand. Methods of separation of sand, Fuller's earth and colloidal matter in molding sands are described. It is best done by a kind of floating process. Ha (22)

Casting in Oblique Position of the Mold. (Das Giessen in Schräglage der Gussform.) H. KALPERS. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Mar. 5, 1932, page 247.
To avoid unevenness of the surface in long castings of more than 50 mm. thickness a slight tilting of the mold is recommended instead of the usual horizontal position of the mold. Ha (22)

Progress in Foundry Practice in Last Half 1931. (Fortschritte des Giessereiwesens im Zweiten Halbjahr 1931.) HANS JUNGBLUTH & PAUL A. HELLER. *Stahl und Eisen,* Vol. 52, April 28, 1932, pages 412-414; May 5, 1932, pages 446-448.
Summary of foundry practice progress for 2nd half of 1931. 76 references. Divided into groups, (1) Casting and Properties of Cast Iron; (2) Melting; (3) Molding and dressing; (4) General. DTR (22)

Green Sand Steel Castings (Stahlnassguss). R. GENWO. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Feb. 21, 1932, pages 75-77.
The article deals with the molding sand to be used for green sand steel castings and the molding practice with special reference to the arrangement of the gates and risers. As to the molding sand a sufficient porosity is of extreme importance. GN (22)

Malleable Iron with Black Core and the Open-Hearth Furnace. (Malleable a coeur noir et Four a Sole.) CHR. KLUIJTMANS. *Revue de Fonderie Moderne,* Vol. 26, Mar. 25, 1932, pages 105-108.
If malleable iron is made in the open-hearth furnace the determination of proper temperature and desired analysis should be made at the time of pouring and not long before. This requires testing methods giving immediate results. The proper temperature can, according to the author, be determined much more accurately by the eye than with a pyrometer; a sample is removed from the furnace and put on the ground, from color and reflection, for which he gives directions, the temperature is determined. A table is given for the ratio of C to Si and the respective pouring temperatures, the fracture of the sample is compared with a table showing the appearance of fractures at different temperatures from which it can be judged whether the proper pouring temperature exists. The method is explained in detail. Ha (22)

Some Observations on Preparation and Use of Synthetic Sand. L. B. KNIGHT. *Transactions & Bulletin, American Foundrymen's Association,* Vol. 3, Jan. 1932, pages 718-728.
Methods of preparation of synthetic molding sands are described. See *Metals & Alloys,* Vol. 2, Aug. 1931, page 150. CHL (22)

A Grain Distribution Index for Sand Grading. CLARENCE E. JACKSON. *Transactions & Bulletin American Foundrymen's Association,* Vol. 2, Nov. 1931, pages 506-512.
Previous methods of grading are reviewed and present development of the A. F. A. grading classification is briefly discussed. A method is developed, based on statistical analysis, that yields a numerical value for a grain distribution index. CHL (22)

FURNACES & FUELS (23)

The Present State of High Frequency Induction Furnaces. (L'etat actuel du four a induction a haute frequence.) J. Minssieuz. *Journal du Four Electrique,* Vol. 41, Mar. 1932, pages 98-102; Apr. 1932, pages 137-140.

A survey is given of the position occupied by high frequency furnaces in the industry. France and England favor ramming dry lining around a steel core placed in the induction coil. Germany sometimes uses damp linings rammed around a wooden core. The capacity of convertor sets is usually equal to the furnace capacity so as to melt the charge in about 1 hour. Sometimes it is more advantageous to use smaller transformers although it slows the melting time and cuts down the efficiency. In a 250 kg. furnace the current consumption varied between 525 and 698 kwh/ton, with an average of 610 kwh/ton for 0.8 C steel and 530 kwh for high speed steel. Examples of the flexibility of the furnace are given. JDG (23)

Investigation of Electric Furnaces for Transition Heating. (Untersuchung elektrischer Oefen für Uebergangsheizung.) Karl Meyer. *Elektrotechnische Zeitschrift,* Vol. 53, Mar. 21, 1932, pages 315-318; Apr. 14, 1932, pages 362-364.

By determining the temperature distribution in the interior of furnaces as a function of time, measuring air velocities and radiation, more exact data than have been available are collected for the design of electric furnaces. A number of examples show the application of the results to the heating of furnaces and rooms. Ha (23)

Solid and Gaseous Fuels in the Iron and Steel Industry. Harald Nielsen. *Fuel Economist,* Vol. 7, Apr. 1932, pages 279-285.

Fuel costs can be reduced in the ferrous industry by utilizing low grade coal, drying it and distilling it at low temperatures. A flow sheet is given showing operations for the production of powdered fuel, producer gas and crude oil. DTR (23)

The Technical Heat Efficiency of a Furnace. (Der feuerungstechnische Wärmeaufwandsgrad eines Ofens.) Gustav Neumann. *Archiv für Eisenhüttenwesen,* Vol. 5, March 1932, pages 471-475.

Report 160 of Heat Section of Verein deutscher Eisenhüttenleute. A résumé is given of 12 important heat formulae for use in the computation of furnace efficiencies, heat losses, heat consumption, etc. DTR (23)

Use of Powdered Coal in the Foundry. (Emploi du Charbon Pulverise en Fonderie.) R. Moine. *L'Usine,* Vol. 41, Feb. 5, 1932, page 27.

The use of powdered coal in the foundry has many advantages. In annealing castings 1 man can operate 6 furnaces of 30 tons each. The desired temperature can be reached rapidly and controlled easily, as can also the furnace atmosphere. A comparison with other fuels shows a saving of 15 to 20% in cost. Ha (23)

Commercial Evaluation of Coke. R. A. Mott. *Journal Institute of Fuel,* Vol. 5, Feb. 1932, pages 193-210.

Coke production in Great Britain and the future demand for oven-coke are discussed. Demand for coke for pig-Fe manufacture depends on the development of the steel industry. On the basis of development for 1900-1918 steel production in Great Britain should be 16,000,000 tons in 1940, requiring 16,000,000 tons of coke. Coke consumption/ton of pig-Fe has been influenced more by the price of coke than by the amount of ore used. When the price of coke has risen, the quality has deteriorated, and vice versa. To protect the Fe manufacturer from deterioration in quality, a sliding-scale basis of payment for blast-furnace coke is suggested. This would be of benefit both to the coke maker and user. Except for hematite-pig production, S is not of sufficient importance to warrant its introduction into a coke specification. For hematite pig, low-S coke is desirable, but it is not possible to evaluate it at present. P is only of significance when pig for acid steel production is being made, for which use coke should not contain more than 0.01% P. Cokes with a ½" shatter index of less than 97.0 should not be used in blast-furnaces. Foundry coke should have low moisture, less than 8% ash, less than 1% and preferably less than 0.8% S, and a 1.5" shatter index of over 90. Beehive coke is preferable for crucible steel melting. Includes discussion. MS (23)

Stoker Fired Furnaces for Metallurgical Work. *Fuel Economist,* Vol. 7, Jan. 1932, pages 128-130.

Operation of the Hagan stoker is described and the underlying principles discussed. This stoker was specially developed as a substitute for hand-fired grates and metallurgical furnaces. Advantages as compared with hand-firing are: (1) A cheap slack coal may be used; (2) fuel saving of 10 to 23%, due to regular feed and system of combustion, are possible and the furnace may be brought up to temperature rapidly; (3) due to even rate of firing, any heating operation can be conducted on a definite time cycle; (4) the amount of dust carried over into the furnace chamber is reduced greatly over both hand-firing and overfeed mechanical stokers; (5) upkeep charges are extremely low; (6) possibility of breakdown during working may be neglected; (7) clinker formation is confined to the firebars at the sides, where it may be removed easily. The use of preheated air is stated to be beneficial. The Stein suspended arch is referred to and illustrated. DTR (23)

Oil-Fired Brass-Melting Furnace. R. S. Livingston. *Engineering & Mining Journal,* Vol. 133, Feb. 1932, page 77.

A simple oil-fired furnace claimed to produce rapid smelting of the charge, or superior grade of brass, and economies in fuel and labor (perfected at the Uvalde Rock Asphalt Co., Blewett, Tex.) is described and illustrated. The welded sheet-Fe shell and burner were made from scrap Fe, standard firebrick formed the lining, and the burner was a 2" tee with a short pipe nipple connected by reducers to the 1" air line and to the ⅜" oil line. Atomized oil is blown into the combustion chamber by the injector and the 1" air connection on the flue end of the furnace serves to control the draft. A heavy Fe lid covers the melting chamber and reduces heat losses. WHB (23)

Steel Recuperators for Heating Mixers. (Stahlrekuperatoren zur Mischerbeheizung.) *Demag Nachrichten,* Vol. 6, Mar. 1932, pages 13-15.

A steel recuperator is described which simultaneously preheats gas and air to be used for heating a mixer, or only air if used for other purposes. The recuperator gives air temperatures of 800° C. For heating a mixer, the gas can be heated simultaneously to 300° C. The maximum temperatures which can be attained amount to 900°-950° C. GN (23)

Application of Coke Oven Gas in the Open Hearth Plant and in the Steel Foundry. (Verwendung von Ferngas im Siemens-Martin-Stahlwerk und in der Stahlgiesserei.) Erich Matejka. *Stahl und Eisen,* Vol. 52, May 19, 1932, pages 481-489.

Combustion reactions and sources of heat losses are discussed and the advantages of gas firing pointed out, together with the effect of various kinds of gas burners. A typical open hearth layout using cold coke-oven gas is described. A high pressure gas line serves the foundry drying and annealing furnaces while a low pressure line serves the open hearth mill and miscellaneous places, such as tempering units, laboratory, etc. The maximum allowable pressure drop along any line is 500 mm. of water with gas velocities approximately 20 to 25 m./sec. Plant costs for gas installation, fuel requirements and economy are enumerated. (23)

Costs Cut in Half When Nitriding in Bell Furnaces. Willard Roth. *Metal Progress,* Vol. 21, May 1932, pages 40-43.

The bell-type nitriders made by the Westinghouse Company are described and operating costs given. Time-temperature cycles and hardness penetration curves for work done in this equipment are drawn. WLC (23)

Electric Annealing and Hardening Installations. (Elektrische Glüh- und Härtanlagen.) Victor Paschkis. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Apr 9, 1932, pages 359-363.

Some new developments in heating resistances and their mountings on the furnace walls, charging devices and heat transmitting arrangements are reviewed and illustrated. (23)

View Points on Electrical Heat Policy. (Gesichtspunkte über Elektrowärmepolitik.) E. Fr. Russ. *Elektrowärme,* Vol. 2 Jan. 1932, pages 2-4.

Electrical heating is of value for industrial purposes because the heating value of electric energy never varies; it is always 860 kg.cal./kwh., whereas all other fuels show fluctuations. Electrical energy can be produced from even the lowest-grade fuels while fuel gases require high-grade coal for their manufacture. For further progress the standard furnace types should be developed so that their price is reduced, second, ideas should be exchanged between furnace manufacturers, and third, testing institutes with laboratories should be created. Ha (23)

Electric Continuous Furnace for Annealing Hoops. (Elektrischer Durchziehofen zum Glühen von Metallbändern.) E. F. Russ. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 22, Feb. 28, 1932, page 118.

A brief description is given of a continuous electric annealing furnace, system Russ, built by the "Industrie" Electrofen G.m.b.H., at Cologne, Germany. The temperature controller used allows the temperature to be regulated so that the fluctuations do not exceed more than ± 5° C. GN (23)

High-Temperature Furnaces with Flameless Surface Combustion. (Hochtemperatur-Oefen mit Flammenloser Oberflächenverbrennung.) Rudolf Schnabel. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Feb. 27, 1932, pages 213-214.

Flameless surface combustion is a process for the combustion of gases in which glowing surfaces energetically accelerate the combustion reaction. A mixture of gas and air is driven through a layer of small pieces (pebbles) of refractory ceramic material and burnt in this layer. The gas mixture is ignited at the surface; the combustion, due to the high ignition velocity, goes spontaneously into the interior of the layer; the whole layer in short time is a glowing mass. Muffles, or other containers can be embedded in the refractory mass to utilize the heat. These furnaces are said to have a very high thermal efficiency; several constructions are described. Ha (23)

Vacuum Electric Furnaces in the Manufacture of X-ray Apparatus. (Le four électrique à vide dans l'industrie radiologique.) R. Sevin. *Journal du Four Electrique,* Vol. 41, Apr. 1932, pages 133-136.

Structural features of a C resistance furnace able to operate at about 0.01 mm. pressure at 1800° C. are given. The furnace is rated at 34 kw and was in use for several years for regasifying metals used in vacuum tube construction. JDG (23)

Coreless Electric Induction Heating. (Elektrische Induktionsheizung ohne Eisenschluss.) W. F. Scher. *Die Naturwissenschaften,* Vol. 19, Dec. 4, 1931, pages 974-980.

The principles of low frequency and coreless high-frequency furnaces are discussed. The phenomena in the latter type of furnaces is demonstrated by the current density distributions in a Cu bolt at various frequencies, which is covered by the formula $q = \pi d \sqrt{2 f \mu H 10^{-9}}$, wherein d = diameter of the Cu bolt, f = frequency of current, μ = permeability, H = conductivity of charge, q = parameter. The heat efficiency N is given by two formulae; if $q < 2$ then $N = \text{const.}\ q^4/H = \text{const.}\ d^4 f^2 \mu^2 H$; if $q > 5$ then $N = \text{const.}\ q/H = \text{const.}\ d \sqrt{\frac{f \mu}{H}}$. The effect of the various factors on the heat efficiency is discussed. Temperature measurements on a steel block are reported which show the influence of the permeability, i.e., a sharp break of the curve due to the appearance of γ-Fe at 720° C. Much attention is paid to the influence of the diameter of pieces of the charges, since the efficiency drops with the fourth power if one goes below the critical value $q = 2.5$. The most favorable diameters of the charged bodies in relationship to the frequencies (50 to 500,000 cycles) are tabulated for the following materials: Cu cold, Fe cold, Pb, Cu liquid, Fe 800° C. and graphite. The high frequency generator and condenser for compensating the reactive volt amperes are discussed. The application of coreless high-frequency furnaces to metallurgical purposes offers great advantages which are dealt with at length in a critical comparison with other furnaces. EF (23)

Vertical Muffle-Annealing Furnace. (Senkrechtmuffelglühofen.) W. Stieding. *Stahl und Eisen,* Vol. 52, Mar. 31, 1932, page 316.

A muffle-annealing furnace for handling special steel sheets, 3500 x 1200 or 3500 x 1600 mm. 1.5 to 2 mm. thick at annealing temperatures of 1050-1160° C. is described. The furnace hearth surface is 1800 x 5000 mm. DTR (23)

Use of Powdered Coal in German Foundries. (L'Emploi du charbon pulverise dans les fonderies de malleable allemandes.) Stotz. *Revue de Metallurgie,* Vol. 28, May 1931, pages 271-275.

See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 24. JDG (23)

Electric Varnish Drying Furnaces. (Elektrische Lacktrockenöfen.) K. Tamele. *Elektrowärme,* Vol. 2, Jan. 1932, pages 16-22.

The advantages of electric furnaces for drying lacquered and varnished articles are explained and several installations described. Ha (23)

Recent Developments in Gas Burners. W. Trinks. *Heat Treating & Forging,* Vol. 18, Jan. 1932, pages 45-47, 55; Feb. 1932, pages 121-123; Mar. 1932, pages 194-196; *Blast Furnace & Steel Plant,* Vol. 20, Mar. 1932, pages 274-279; Apr. 1932, pages 352-354.

The design of induction and luminous-flame burners is discussed, including cylindrical induction burners of the high-pressure type in which gas under pressure induces air, and the low-pressure type in which air induces gas, Venturi, 2-stage and multi-stage types. The constancy of the air-to-gas ratio is considered. MS (23)

Heat-Transfer in Non-Ferrous Metals in Heat-Treating Furnaces. (Der Wärmeübergang an Nichteisenmetallen im Wärmofen.) G. Wagener. *Zeitschrift für Metallkunde,* Vol. 24, Feb. 1932, pages 35-39.

The heat-transfer coefficients for non-ferrous metals are considerably less than that for Fe because of the diminished absorption of radiation by the brighter surfaces. Curves and mathematical expressions are given for the heat-transfer of Al, Cu, and brass, and compared with those for Fe. RFM (23)

Economies to be Derived from the Use of Gas Industrially. C. M. Walter. *Journal Institute of Fuel,* Vol. 5, Feb. 1932, pages 176-183.

Includes discussion. The advantages of gas as an industrial fuel are summarized. By substituting gas for coke in the production of forgings and machined and heat-treated parts, the total production costs were reduced in 2 cases, in spite of the higher cost of the gas. The savings were effected principally by the reduction of wastage of material. Recuperation and regeneration are discussed and the thermal efficiency of heat application for industrial heating operations using gas is presented tabularly. MS (23)

Furnaces Placed in Production Lines. G. T. Williams. *Metal Progress,* Vol. 21, Mar. 1932, pages 27-31.

The efficiency of the plant of the Cleveland Tractor Co. was greatly increased by placing heat treating equipment in the production line. A brief account of the type, arrangement and capacity of equipment is given. WLC (23)

Application of Gas Heat to Forging. *Heat Treating & Forging,* Vol. 17, Nov. 1931, pages 1059-1061, 1068.

From the Fifth Annual Report of the Committee on Industrial Gas Research of the American Gas Association. W. E. Jominy has published data on the rate of heat penetration, and on burning and overheating of steel at forging temperatures, which show the superiority of gas over other fuels from the metallurgical point of view. Results of investigations on the scaling of steel at forging temperatures have been published by W. E. Jominy and D. W. Murphy. 6 subjects remain to be covered, including studies on the influence of 0.05, 0.1, 0.2 and 0.5% SO_2 in oxidizing and reducing furnace atmospheres on S.A.E. 1015, 1030 and 1040 steels and also on some of the more common alloy steels used for forgings. Under usual conditions, gas is at a disadvantage as compared with oil, because heat transfer is slower, an adherent scale difficult to scrape from the steel is formed and excessive furnace repairs are required. Any appreciable increase in the reducing condition of the atmosphere so as to reduce scaling was accompanied by a sharp reduction in the efficiency of the fuel as well as a reduction in the rate of heat transfer. A new method of combustion designated "diffusion flame combustion" has been evolved, in which the air for combustion reaches the gas by diffusion through the burning flame rather than by any form of premixing, causing the gas to burn with an intensely luminous flame which is highly radiant within itself. The method has been applied to forging furnaces, but it has involved the development of a new technique in burner construction and furnace design. Full-scale furnaces have been installed in several plants. Results to date indicate that the heating rate with gas using "diffusion flame combustion" may be faster than with fuel oil, the quality of the steel is superior, there is a total absence of scale, and full thermostatic control may be applied to the furnaces, giving assurance against overheating or burning of the steel. MS (23)

Smoke—A Study of Aerial Dispense Systems. R. Whytlaw-Gray & H. S. Patterson. Longmans-Green & Co., New York, 1931. Cloth, 5¾ x 9 inches, 192 pages. Price $4.50.

This book deals with the general and fundamental principles which underlie the behavior of systems consisting of fine particles dispersed in air. It does not discuss the application of the conclusions to technical questions of industrial smokes.

It deals largely with measurements of the number, size and distribution of the particles, the factors which affect these relations, and the fundamental theories involved. Precise, rather than convenient, methods are used. H. W. Russell (23) -B-

Fuel Requirements of Steel Mills. *Rolling Mill Journal,* Vol. 6, Feb. 1932, pages 51-54.

A general discussion presenting heat balances for coke-ovens, blast furnaces and melting and heating furnaces, and power and steam requirements of steel plants shows that for the best practice a total of 15,793 B.t.u. is required. Cost of fuels per 1,000,000 B.t.u. must be considered. Many heating operations can be conducted at a lower cost even with higher heat consumption by the use of a different fuel. MS (23)

Application of Waste Heat Boiler to Open-Hearth and Heating Furnaces. G. R. ADAMSON. *Iron & Coal Trades Review,* Vol. 124, Jan. 29, 1932, pages 204-205.

The value of waste heat boilers to an installation is discussed and the size of such boilers is compared to the fuel-fired boiler. Several types of modern waste heat boilers are described and their effect on furnaces explained. Even if a regenerator for preheating gas and air is used sufficient heat is still left in the combustion gases to make the installation of a waste heat boiler economical. Ha (23)

Rotary Furnaces in the Foundries of Ferrous and Non-Ferrous Metals. (L'Emploi des Fours Rotatifs dans le Dormaine des Fonderies de Métaux Ferreux et Non-Ferreux.) BOUTIGNY. *Revue de Fonderie Moderne,* Vol. 26, Apr. 25, 1932, pages 133-137.

The advantages of rotary furnaces for Fe and bronzes are pointed out. They often contribute to a more economical production of castings. The losses due to burning are negligible, the metal is completely killed and of good quality in spite of the low content of C and Si. The clay lining behaves very well under various compositions of the charge, with temperatures between 1565° and 1640° C. for 1 hr. 30 min.; the consumption of oil was 14 to 17% of the weight of the charge. The results of several test runs are given. Ha (23)

The Influence of Operating Conditions on the Manufacture of Producer Gas. (Ueber den Einfluss der Betriebsbedingungen auf die Erzeugung von Generator-gas.) M. FULDA & G. GEHLHOFF. *Glastechnische Berichte,* Vol. 10, Mar. 1932, pages 131-149.

The chemical processes in gas producers depend essentially on the temperature of the bottom zone in which the principal chemical conversions take place. In the oxidation zone the O of the supplied air combines with C to form CO_2 while the added H_2O vapor remains intact. The heat produced is utilized in the following zone in the reduction of the H_2O vapor and CO_2. The temperature of this reduction zone determines the efficiency of the gasification. Sufficient height of the column of material increases the production and the heating value of the gas. The limit of addition of steam which can be disintegrated completely in the gas producer is for all fuels about 40 kg./100 kg. of gasified C; older fuels can give a better gas with up to 77 kg./100 kg., but younger fuels do not show an improvement in quality. 35 references. Ha (23)

Recent Improvements on Cupolas which have been Tried Previously. (Altes als Neues beim Kupolofenbetrieb.) H. KLOSS. *Feuerungstechnik,* Vol. 19, Oct. 15, 1931, pages 156-158.

Historical proof is presented that recent improvements in cupola operations are not really new ideas. Such improvements include the preheating of the blast, special arrangement of the tuyères, large output by special copula profiles, and stamping out of the cupola bottom. EF (23)

Means to Increase Temperatures in the Open Hearth Furnace. A. J. BOYNTON. *Blast Furnace & Steel Plant,* Vol. 20, Jan. 1932, pages 66-70.

The advantages in using mixed gases as open-hearth fuel are discussed. High temperature is most essential in the melting state of the open-hearth process and in the sub, sequent clearing stage which precedes the boil. These high furnace temperatures can be attained with a minimum use of fuel by means of a new development of open-hearth regenerator. For dissociating the hydrocarbons of the mixed gases, air and gas are regenerated above 2100° F. The furnace should be provided with means of allocating the exit gases between the air and gas regenerators. The latter should be larger in proportion to the air regenerator, than has been the custom with producer gas, the proportionate size being 1.25-1.40 air to 1.00 gas. Regularity of regenerator temperatures is a highly desirable condition which is not fulfilled by the ordinary type of regenerator. The principles of the Brassert regenerator, which have been applied to the blast furnace stove, have been applied to the open-hearth regenerator. The checkers are Peterson-type open checkers, varying in length, but with width and thickness constant in the successive zones of the first pass. The openings are successively reduced in area. This maintains velocity and promotes turbulence, while also adding to brick weight and heating surface. In the second pass, the checkers are open-type and 4 in.² In this pass, inserted checkers are used, full star-shaped checkers being used in the bottom zone, intermediate shape in the middle zone, and plain diagonal in the top zone. An induced draft fan is required. This construction has 65% more heating surface and 60% more weight of brick than a standard open-checker made of standard 9" brick. To maintain high temperatures it is necessary to prevent infiltration of air. As it is not possible to make a furnace air or gas tight, the furnace should be kept under a slight positive pressure. MS (23)

Progress in Steel Plants During the Year 1930. (Fortschritte im Stahlwerksbetrieb im Jahre 1930.) H. ILLIES. *Feuerungstechnik,* Vol. 19, Nov. 15, 1931; pages 177-179; *Rolling Mill Journal,* Vol. 5, June 1931, pages 433-435.

The improvement of the efficiency of open hearth furnaces during 1930 is reviewed. Outputs have been increased due to improved melting conditions; the compromise between American and German melting practice by the Venturi or Danforth furnace end is shown. The wear and lifetime of furnace roofs, the Terni furnace end, the furnace of the Laclede Steel Co. (100 tons capacity) and the problem of automatic heat regulation are discussed. JN+EF (23)

Electrically Heated Core Drying Furnace. (Ein elektrisch beheizter Kerntrockenofen. E. FR. RUSS. *Elektrowärme,* Vol. 2, Apr. 1932, pages 86-88.

A continuous furnace of an elevator-like construction and with ventilation for carrying-off the moist air and gases is described. The height is 44 ft.; a maximum temperature of 300° C. is obtained with 450 kw. For an hourly output of 1600 kg. of cores, 180 kwh. are required. Ha (23)

Furnaces for Continuous Heating and Normalizing of Sheets. (Balkenherdöfen zum kontinuierlichen Wärmen und Normalglühen von Blechen.) *Stahl und Eisen,* Vol. 51, Dec. 31, 1931, pages 1620-1622.

The furnaces developed by the Surface Combustion Co., Toledo, Ohio, are described. GN (23)

Electricity as a Source of Heat in the Arc Furnace for Iron, Steel and Related Fields of Application. (Die Elektrizität als Wärmequelle für Eisen, Stahl und verwandte Anwendungsgebiete.) W. BRAUMUELLER. *Elektrowärme,* Vol. 2, Apr. 1932, pages 115-118.

The 3 principal types of electric arc furnaces are described, i.e. the Girod furnace where the current flows from one electrode through the charge to the other electrode, the Heroult furnace, where the arc is formed between the electrodes and charge, and the Stassano furnace where the arc burns only between the electrodes and the charge is heated by its radiation. The most commonly used type for the production of steel and gray Fe is the Heroult type; units up to 10,000 kw. are now built. The electrical conditions are discussed in detail; the efficiency of the furnace has been increased by increased furnace voltage whereby the ratio of the total resistance to the useful resistance is improved. The methods of regulation of the arc in order to reduce current fluctuations and to improve the power factor are described. As the greatest losses are due to the leads from transformer to furnace the former is installed as close to the furnace as can be done for practical reasons. The general arrangement of such furnace installation is described with control and signal apparatus. Ha (23)

Resistors Embedded in Muffle Walls. Correspondence from E. W. EHN & H. DIERGARTEN. *Metal Progress,* Vol. 21, Apr. 1932, pages 69-70.

Electric annealing furnaces of improved design are replacing gas-fired equipment in German plants. Greater efficiency in continuous furnaces is secured by using fire clay muffles approximately 1" thick with the heating element embedded in the fire clay mass and by employing powdered kieselguhr as an insulating material. Thermal efficiencies of 80% are attained. WLC (23)

The Different Types of Electric Melting Furnaces in Steel Works. (Die verschiedenen elektrischen Schmelzofenarten im Eisenhüttenbetrieb.) R. GROSS. *Elektrowärme,* Vol. 2, Jan. 1932, pages 4-9.

Direct arc-furnaces, low frequency induction furnaces, high-frequency furnaces with induction heating, and reduction furnaces for ferro-alloys are described, their principles and pecularities explained, and tables of capacity and energy consumption given. Ha (23)

The Use of Ammonia Gas as a Source of Hydrogen for the Production of Reducing Atmospheres. J. R. GORDON. *Canadian Chemistry & Metallurgy,* Vol. 16, Apr. 1932, page 101.

NH_3 is synthesized from N and H in the presence of a catalyst at 400°-500° C. and pressures of 100-200 atmospheres. The reverse action proceeds rapidly in the presence of an Fe catalyst at 600° C. under normal pressure. A set-up consists of a silica tube filled with steel wool and heated to 600° C. in an ordinary combustion furnace. The equipment is easily set up and can be assembled from standard parts. WHB (23)

Blast-Furnace Engineering. With Particular Reference to the Dagenham Furnace of the Ford Motor Co., Ltd., and the Pretoria Furnace of the South African Iron and Steel Corporation, Ltd. W. R. BROWN. *Iron & Steel Institute, Advance Copy* No. 5, May 1932, 20 pages; *Metallurgia,* Vol. 6, May 1932, pages 1-5; *Iron & Coal Trades Review,* Vol. 124, May 6, 1932, pages 741-747, 756; May 20, 1932, pages 823-833.

After a brief discussion of the factors that must be considered in designing a blast-furnace plant, 2 plants are described. Both of the furnaces are designed to produce 500 tons of iron/day. Materials for the Ford furnace are received by water and those for the African furnace by rail. Accessories for the furnaces are described. Plans and photographs of the plants are included. Ha + JLG (23)

Industrial Heating Processes. C. FOSTER CLARK. *American Gas Journal,* Vol. 136, May 1932, pages 25-27.

Gas fuel gives instant and positive control of the furnace atmosphere and temperature and thus prevents scale formation. New gas-operated systems of carburizing give a better case with the elimination of carburizing boxes and compounds. Continuous bright annealing in gas furnaces is now economical. Gas furnaces have been developed in which tools are hardened in a controllable atmosphere, protected from outside air and combustion gases by a muffle, sealed at the opening by an adjustable burning curtain of gas. Among the advantages listed for gas fuels over all other types are: Cleaner and easier to handle than solid or liquid fuels; adaptable to close control of temperature and furnace atmosphere; quicker to heat than electricity; flue gases produced create furnace pressures, carry heat by convection, and produce any desired furnace atmosphere; temperature can be controlled more closely than with any other source of heat. Data given for each of the following operations show gas fuel to be the most economical: Cyanide pots, stereotype metal melting, carburizing, annealing, bright annealing and japanning. CBJ (23)

Smoke Prevention in a Steel Works. H. CLIFFORD ARMSTRONG. *Fuel Economist,* Vol. 7, Apr. 1932, pages 267-269.

A review of steps taken to reduce the emission of black smoke in the Sheffield area, especially in connection with billet-heating furnaces and sheet-rolling mills is given. Gas was adopted as the heating medium in mill furnaces. A gas fired sheet-reheating furnace which gave good results in eliminating smoke is described. DTR (23)

New Type Electric Furnace Electrode. (Nouveau type d'electrodes pour fours electriques.) *Journal du Four Electrique,* Vol. 41, Feb. 1932, page 62.

French patent 707,729 describes hollow electrodes possessing many advantages. JDG (23)

Industrial Applications of Electrical Heating. (Applications Industrielles du Chauffage Electrique.) *L'Usine,* Vol. 41, Jan. 22, 1932, pages 31-37.

A few installations of electric forging, heat treating and melting furnaces are described, among which are American examples. Ha (23)

The Present Status of Resistance Furnace Construction. (Die gegenwärtige Lage im Widerstandsofenbau.) V. PASCHKIS. *Die Metallbörse,* Vol. 21, June 6, 1931, pages 1060-1061.

See *Metals & Alloys,* Vol. 3, July 1932, page MA 224. EF (23)

REFRACTORIES & FURNACE MATERIALS (24)

The Suitability of Various Refractory Materials for Lead Refining Furnaces. (Die Eignung verschiedener feuerfester Materialien für Bleiraffinieröfen.) E. R. THEWS. *Feuerfest-Ofenbau*, Vol. 7, June 1931, pages 84-86.

The peculiar difficulties due to the corroding effect of the molten Pb and the superheated Sb slag on the linings of Pb refining furnaces are anticipated. The more recent commercial refractories used as furnace construction materials are discussed i.e. mainly quartz, sillimanite, chromium, chromium ore, zirconium, carborundum, silundum, crystolon and andalusit bricks. Unfortunately most of these refractories are too expensive. A comparison between burnt fire clay and magnesite bricks is made and the superiority of the burnt fire clay bricks due to their technological properties and low initial costs is stated. Some practical suggestions are furnished for cutting down extreme corrosive action of the Sb-slag. EF (24)

Refractory Materials. Fireclay Bricks. COLIN PRESSWOOD. *Metallurgia*, Vol. 5, Mar. 1932, pages 169-170, 172.

A discussion of various bricks and their properties. 14 references. JLG (24)

Investigation of the Influence of Slag on Refractory Bricks by Means of a New Testing Method. (Untersuchung des Einflusses von Schlacke auf feuerfeste Steine an Hand eines neuen Prüfverfahrens.) J. SCHAEFER & F. BAUHAUER. *Feuerfest-Ofenbau*, Vol. 7, Mar. 1931, pages 33-36.

Critically discusses the testing method of Mellor & Emery (*Transactions Ceramic Society*, Vol. 18, 1918/19, page 230) in which the dust is blown in a downward direction on horizontal bricks. The writers designed a small testing furnace in which slag is blown in an atomized state on the vertical refractory brick. Tests are carried out in which silica and magnesite bricks were exposed to the scorification of metallurgical slags. The testing results are collected in 4 tables and the authors establish a method of quantitative determination of the degree of scorification. EF (24)

Mining and Processing Fireclay. GEORGE J. YOUNG. *Engineering & Mining Journal*, Vol. 132, Apr. 1932, pages 215-218.

An illustrated description of the plant and the processing of fireclay at the Stockton Fire Brick Co., San Francisco, Cal. WHB (24)

Some Properties of Chrome Spinel. C. W. PARMELEE & ABDE ALLY. *Journal American Ceramic Society*, Vol. 15, Apr. 1932, pages 213-225.

Expansion curves of five chrome ores, covering a wide range of chemical composition from different localities, were found to be more or less uniform in the temperature range 25-1250° C. There is a marked increase in expansion in all samples above 1000° C. The non-magnetic nature of the ores suggests the presence of Fe in the ferrous form. Ores high in both Cr_2O_3 and SiO_2 tended to give high expansions. There is a decrease in the mean expansion values in the interval 25-1250° C. with the decrease in the initial specific gravities; the decrease, however, is not proportionate. There is an increase in the specific gravity of the ore when heated, but the increase is not proportional to the temperature rise. The purity of the ore cannot be definitely ascertained by its specific gravity determination or by X-ray examination. Lattice dimensions were inversely proportional to the Al_2O_3 content of the ores. The length of the edge of the unit cube varied from 8.283 $\pm$ 0.001 to 8.179 $\pm$ 0.002 A. U. Theoretical densities computed by extending a method generally applicable to alloys of continuous substitutional types had a maximum difference of 1.3% between the theoretical and the actual values in the case of ores with complete analyses available and an optimum difference of 5.93% where some of the undetermined constitutents were estimated. WAT (24)

Notes on Kiln Markings of Fireclay Brick. S. M. KIER. (General Refractories Co.). *Heat Treating & Forging*, Vol. 17, Dec. 1931, pages 1139-1140.

Paper read before the American Refractories Institute, Oct. 9, 1931. Major cause of kiln marking is the deformation or compression of a portion of the brick, resulting from the load which it has to carry in supporting the upper courses. Load tests were conducted, one being the standard test of 25 lb./in.² in which the temperature is raised in 4⅓ hr. to 2462° F. and then held for 1½ hrs. In the second test, the same temperature was reached in 91½ hrs. and maintained for 1½ hrs. Results showed that the brick began to deform at a lower temperature in the long-time test and that, in general, the total deformation was greater than in the short-time test. Another set of experiments using the two rates of heating was made. The load, however, was not applied until the final temperature was reached. It was found that the long-time test gave a much lower final deformation. Second type of marking results from "secondary expansion" which occurs at comparatively low temperatures. Laboratory tests show that a very light load of about 0.5 lb./in.² will prevent this expansion. Suggests that, in order to produce the best brick, overcoming the troubles of kiln marking, and insuring their maximum life in service, they should be fired at a sufficiently slow rate and at a temperature which is sufficient to prevent shrinkage. MS (24)

Zirconium Bricks for Metallurgical Furnaces. (Zirkonsteine für metallurgische Öfen.) W. HERMANN. *Feuerfest-Ofenbau*, Vol. 7, Oct. 1931, pages 146-147.

Points out how to meet the drawbacks of Zr-material, i.e. the large initial costs and the considerable brittleness. The initial materials and their natural occurrence are reviewed. The advantages as high melting point (3000° C.) low coefficient of thermal expansion (8.4 x 10^{-7}), low heat conductivity, large resistance to temperature breaks and to chemical attacks are emphasized. The favorable compression strength, only surpassed by carborundum, is however accompanied by great brittleness. Little information on the commercial production methods of ZrO material is known and only the method of H. C. Meyer is given. EF (24)

Modern Developments in Furnace Refractories. *World Power*, Vol. 17, Jan. 1932, page 58.

Recent developments, by the Babcock and Wilcox Co., in the manufacture of refractories from kaolinic materials are of interest as showing the possibilities of this class of material. A refractory kaolin is used for making the company's No. 80 firebrick and other products. This material is calcined to completely eliminate its shrinkage and to develop the maximum amount of mullite. It is then sized, bonded, molded and burned to produce a recrystallized structure and insure uniformity of size, texture and quality, without warping or kiln marking. The analysis of the firebrick is as follows, silica 51.96%, iron oxide 0.57%, titanium oxide 1.73%, aluminum oxide 45.38%, calcium oxide 0.10%, magnesium oxide 0.22%, sulphur trioxide 0.04%. Service results appear to indicate that the brick has a very high resistance to rapid changes in temperature. Shrinkage and expansion curves show that there is no permanent volume change up to 2900° F. and only a slight shrinkage change up to 3000° F. The average coefficient of expansion is 0.00000242, or considerably less than the figures for other representative firebricks. The point at which permanent volume change begins is about 2900° F. instead of the usual 2300° F. A further important feature is the load-bearing capacity of the firebrick at high temperatures. Refractory cements with the same base as the No. 80 firebrick have been developed to meet various furnace conditions. The melting point of this cement is 3180° F. and its vitrification point 2200° F. It forms a strong bond at all temperatures and may be used up to within 25° of its melting point. WAT (24)

A Comparison of the Rates of Flow of Water and of Air Through Refractory Materials. F. H. CLEWS, E. O. MILLS & A. T. GREEN. *Institution of Gas Engineers, 22nd Report of the Refractory Materials Joint Sub-Committee, Copyright Communication* No. 39, Sept. 25, 1931, pages 23-25; *British Refractories Research Association Bulletin*, 25, 1931, pages 48-54.

The order of H_2O penetrability of refractories of permeability to H_2O is identical and very nearly the same as permeability to air. AHE (24)

A Contribution to the Investigation of the Heat Conductivity of Refractory Materials with Particular Consideration of Magnesite Bricks. (Beitrag zur Untersuchung der Wärmeleitvermögens feuerfester Steine unter besonderer Berücksichtigung der Magnesitsteine.) M. BOETTICHER. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Akt.-ges, Dortmund*, Vol. 2, No. 10, 1932, pages 235-248.

Specific gravity, volumetric weight, porosity, gas permeability, linear expansion, average heat expansion coefficient, softening at high temperatures under load were measured and the data, together with the chemical analysis are tabulated. X-ray pictures of the structure are also given. The principal results are that heating magnesite bricks at a temperature considerably above their burning temperature changes specific weight and grain size of the brick; these changes have a direct bearing on the heat conductivity which increases with increased specific gravity and grain size. The change of the heat conductivity is, however, small. A relation between heat conductivity and gas permeability and porosity could not be stated. 25 references. Ha (24)

The Permeability of Refractory Materials to Gases. Part I. Experiments with Fire Clay and Silica Products at Ordinary Temperatures. Part II. Experiments with Fire Clay and Silica Products at Temperatures up to 500° C. F. H. CLEWS & A. T. GREEN. *Institution of Gas Engineers, 22nd Report of the Refractory Materials Joint Sub-Committee, Copyright Communication* No. 39, Sept. 1931, pages 5-15; Sept. 1931, pages 16-23; *British Refractories Research Association Bulletin* 25, 1931, pages 24-47; *Bulletin* 26, 1931, pages 44-56.

The true and apparent porosity and minimum and maximum permeability of representative samples of silica and fire clay products were determined. There is no definite relationship between percentage porosity and permeability coefficients. Data on permeability in 3 different directions show that the permeability coefficient is much less perpendicular to the 9 x 4½ inch face than in either of the other 2 directions. Part II. A method is described by which the permeability to N of 5 fire clay, 5 silica and 1 siliceous material has been measured directly at temperatures up to 500° C. As the temperature increases, permeability decreases in a manner almost independent of the nature of the material and the value of its permeability coefficient at ordinary temperatures, For a temperature increase from 10° to 500° C. the permeability is reduced to almost ½ its value for fire clay products and to slightly less than this for silica. The increase in gas viscosity with rise in temperature accounts almost quantitatively for the decrease in permeability, but small variations in the results for the different products suggest the dependence to a minor degree on a further factor related to the pore structure of the material. The inversion between 100° and 250° C. in the low specific gravity forms of silica may account for the divergence of the results between the fire clay and silica products. AHE (24)

The Heat Conductivity of Ceramic Refractory Materials. Calculations of Heat Conductivity from the Constituents. (Die Wärmeleitfähigkeit keramischer feuerfester Stoffe. Ihre Berechnung aus der Wärmeleitfähigkeit der Bestandteile.) A. EUCKEN. *Forschungsheft* 353, Supplement to *Forschung auf dem Gebiete des Ingenieurwesens*, Vol. 3, Mar.-Apr. 1932, 16 pages; *Technische Blätter der deutschen Bergwerkszeitung*, Vol. 22, May 1, 1932, page 243.

The experiment was divided into 3 parts: (1) including a general point of view and formulae for an approximate (relative) calculation of the temperature curve of the possible heat conductivity; (2) including exact methods for calculating the heat conductivity of binary aggregates and ternary aggregates with high and low glass content; (3) special calculations of the heat conductivity of certain ceramic materials. GN + MAB (24)

GASES IN METALS (25)

The Influence of the More Common Elements in Inhibiting Needles in Nitrogen-Rich Steels and Arc Welds. L. W. Schuster. *Iron & Steel Institute, Advance Copy* No. 13, May 1932, 27 pages.

Welded layers, and nitrided, carburized and decarburized specimens of varying composition were examined to determine the effectiveness of several elements in preventing the formation of nitride needles. It was necessary to cool the specimens very slowly, for nitride needles separated from some samples on extremely slow cooling but not on somewhat more rapid cooling. C did not inhibit the formation of the needles. About 1% Mn or 1.1% Si tended to inhibit their formation. S and P apparently had no effect. Between 2 and 2.5% Ni or 0.9% Cr prevented the formation of the needles. A high Mn content welding rod did not prevent N absorption. 7 references. JLG (25)

Effect of Nitrogen on Steel. A Practical Consideration as Applied to Commercial Open-Hearth Steel. Frank W. Scott. *Industrial & Engineering Chemistry,* Vol. 23, Sept. 1931, pages 1036-1051.

48 references. The effect of N on steel has been magnified by nitrifying regular 8-ton ingots and comparing the physical properties of this steel to the regular product. N has been found to have 4 times the effect of the same amount of P. An increase of 0.01 % in N content was sufficient to cause a marked difference in the physical properties of the steel. The coefficient of effect increased with the increase of carbon. An equation has been derived whereby the effect of an increase of nitrogen on the elongation of the steel may be calculated quite accurately. Also the equation may be used to indicate the benefits to be derived by using a denitrifying agent. The average amount of N found in open-hearth steel was 0.0045 %. Such an amount was not found to be seriously detrimental to the quality of the steel. MEH (25)

Chemical and Electrical Phenomena on Gas-Charged Metallic Surfaces. (Ueber chemische und elektrische Vorgänge an gasbeladenen Metalloberflächen.) R. Suhrmann. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 203, Dec. 30, 1931, pages 235-244.

The property of some metals to adsorb certain gases on their surface to an extraordinary degree is discussed; the formula of Van der Waals does not hold good for all metals and gases; the author assumes therefore that electrostatic causes have to be used for an explanation. Metals are distinguished from other elements of the periodic system by the fact that they emit glow electrons at high temperatures, and photoelectrons on radiation with short-wave light. The formula of Richardson permits the calculation of this emission. If an atom whose valency electrons are only loosely bound together is brought into contact with the surface of a metal with great electron affinity the valency electron is pulled into the metal surface and the electron affinity is hereby partly saturated; this is explained by the Einstein formula connecting the quantum energy with the electron velocity. Polarization and chemical border phenomena are closely related with adsorption. 12 references. Ha (25)

Blowholes and Porosity in Non-Ferrous Castings. N. P. Allen. *Foundry Trade Journal,* Vol. 46, Apr. 14, 1932, pages 229-230.

A report of a paper presented at a joint meeting of the Institute of British Foundrymen and British Institute of Metals, in which the causes of cavities in non-ferrous castings were dealt with in some detail. The questions of gas solubility, of water vapor and hydrogen contamination, are discussed and attention is directed to methods of deoxidizing metals and alloys. OWE (25)

The Determination of Gases in Metals, Especially Oxygen in Iron and Steel, According to the Vacuum Extraction Method.) H. Diergarten & E. Piwowarsky. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 9 pages.

See *Metals & Alloys,* Vol. 1, Sept. 1930, page 745. (25)

A Review of Work on Gases in Copper. O. W. Ellis (Ontario Research Foundation). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 478, Feb. 1932, 28 pages.

Bibliography of 30 references. A critical review of the work done on this subject. Considers results of plant observations as well as laboratory tests. JLG (25)

The Degassing of Metals. F. J. Norton & A. L. Marshall (General Electric Co.). *American Institute Mining & Metallurgical Engineers, Preprint,* Feb. 1932, 28 pages.

The rate of extraction of gas from Mo used as electrodes in vacuum tubes was determined. To remove the gas completely it is necessary to heat to 1760° C. in a vacuum in the neighborhood of 0.001 micron for a time dependent on the thickness of the sheet. The gases extracted were CO and N. The N is the more difficult to remove. Some work was also done on W, Ni and C. The equipment used and the calculations are discussed in detail. Some tests on the absorption of gases are also described. 8 references. JLG (25)

The Oxide Contents of Aluminum and Methods for Its Determination. (Ueber den Oxydgehalt des Aluminiums und Methoden zu seiner Bestimmung.) H. Loewenstein. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 199, No. 1/2, July 8, 1931, pages 48-56.

The content of oxide in Al can amount, especially in old Al, to several percent. As difficulties in casting of Al have been ascribed to presence of oxide the author investigates the two methods of Jander and Hahn and finds that by testing Al in containers of pure alumina the oxide content can be determined exactly; presence of silica falsifies the results. The amount of oxide present in Al does not depend upon its origin but is only due to surface oxidation. Ha (25)

The Thermo-Forces of Palladium, Iron and Palladium-Silver Alloys Charged with Hydrogen. (Ueber die thermokräfte von mit Wasserstoff beladenem Palladium, Eisen und Palladium-Silberlegierungen.) Rolf Nuebel. *Annalen der Physik,* Ser. 5, Vol. 9, 1931, No. 7, pages 826-838.

The thermo-force of these materials is strongly influenced by the amount of hydrogen in the metal. The alloy Pd-Ag has a pronounced maximum of the thermo-force at 40% Ag. Test methods and results are described. Ha (25)

Gases in Metals. (Gase in Metallen.) THEWS. *Die Metallbörse,* Vol. 21, June 20, 1931, pages 1157-1158. 11 references.

The more recent investigations on the occurence of gases in metals are reviewed with emphasis on H and O_2, N_2, CO, CO_2, SO_2. EF (25)

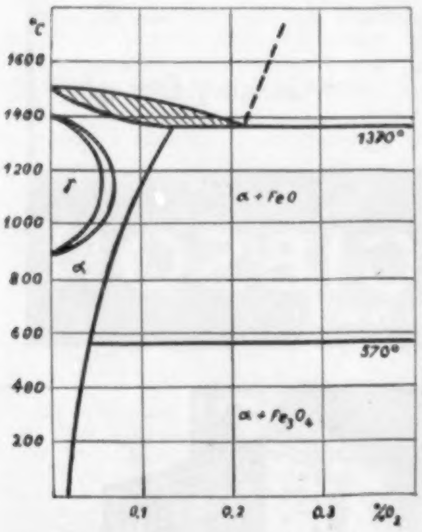
Influence of Gases on Metals and Influence of Melting in Vacuo. WILHELM ROHN (Heraeus Vacuumschmelze, A. G.). *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 470, Feb. 1932, 8 pages.

Briefly discusses the occurrence and effects of gases in metals. Gases can be removed by melting in vacuo. To do this it is necessary to actually melt in vacuo and not simply to allow the molten material to solidify in vacuo. Impact tests have proved that vacuum melting improves physical properties. Even with 4-ton furnaces the increase in cost due to vacuum melting is about 10c per lb. The technique has, however, developed to a point where it is possible to start such furnaces with a molten charge, and the additional cost in this case should be between 1 and 2c per lb. JLG (25)

Controlled Atmospheres for Annealing and Welding. J. F. T. BERLINER. *Metal Progress,* Vol. 21, Apr. 1932, pages 39-43.

Inert and reducing atmospheres for annealing, scale removing, flame cutting, welding and brazing may be economically supplied by a device now being manufactured by the DuPont Ammonia Corp. for the catalytic dissociation of liquid ammonia. The dissociator, which is only 3 feet high and 14" in diameter is capable of supplying 400 ft.^{3} of gas (75% H_2, 25% N_2) per hour with very little attention from the operator. The cost is 0.155c/ft.^{3} with ammonia at 6c/lb. If an atmosphere of pure N_2 is desired the hydrogen may be burned and removed as H_2O by a special attachment. One 100 lb. container of liquid NH_3 yields a volume of very pure N_2 equivalent to the contents of 39 standard cylinders of compressed N_2. The cost of the apparatus is of the order of $600. WLC (25)

Oxygen in Iron. (Tlen w zelazie.) I. FESZCZENKO-CZOPIWSKI & S. ORZECHOWSKI. *Prace Badawcze PWU,* 1931, No. 2, pages 5-38.



49 references. As a result of investigations, and of observations, a diagram Fe-FeO was constructed. The area of γ-Fe is limited to 0.07% O_2 (a number determined by Inouye). Oxygen dissolves in Fe at room temperature up to 0.02%, when at temperature of solidus the solubility increases to 0.13% O_2. About 0.21% O_2 can be dissolved in liquid Fe at 1370° C. The fact that such a low melting point of Fe in presence of O has not been observed, is the objection to this diagram. However this diagram can explain the abnormal grain growth during heat treatment of steel containing O as the O drives out the C from the solid solution. The same explanation can be given to the anomalies in C cementation, and to troostitic spots in quenched steels. A steel not sufficiently deoxidized contains grains of γ-Fe beside the grains of α-Fe. The difference in dilatation of these both kinds of grain during allotropic transformation causes the brittleness of steel. ZJ (25)

Gases Evolved from Molten Metal. HENRY D. HIBBARD. *Iron Age,* Vol. 129, Mar. 10, 1932, pages 611-612.

Gases evolved from molten metal in open-hearth furnace are chiefly those causing the "boil" and those which the boiling gases carry off. Composition of boiling gases changes, as does their volume, as the heat progresses from melting down to finishing. Cooling of molten metal in mold lessens its power to hold the gases in solution. Killed steel containing usually about 0.25% Si evolves no bubbles of gas in mold. Partly killed steel evolves gas in mold in quantity inversely proportional to the degree of killing. Segregation seems to be largely an effect of escaping gas bubbles in mold which, by keeping the liquid in motion, make it wash off and mix with itself the rejected impure matter from crystallizing steel. Dead steel emits no gas and segregation in it is comparatively slight. VSP (25)

Gases in Pipe Cavity and in Gas Holes in Ingots. HENRY D. HIBBARD. *Iron Age,* Vol. 129, Mar. 24, 1932, page 715, adv. page 20.

There are 3 common kinds of gas holes in commercial steels: (1) Sinkholes, (2) intermediate holes, and (3) central holes. In properly made rimmed steel the gas holes are so located that they do little or no harm. Pipe gases are in part ammonia but in varying proportions. All 3 common kinds of gas holes are exemplified in ordinary rimming steel. Intermediate holes, which occur only in rimming steel are in a zone extending all around and the whole length of ingot inside the sinkholes, with a secondary layer of sound metal between them. Abnormal steels may have gas holes not like any of the 3 common kinds mentioned. Some ingots may be sound inside though bad on the surface. VSP (25)

Degasifying of Light Metals. *Chemical Age,* Vol. 24, Mar. 1931, pages 208-210; *Metallbörse,* Vol. 21, Apr. 4, 1931, page 631.

Investigations of different people have shown that gas may be partially removed from molten light metal alloys by introducing chlorine gas. Different chlorides and tetrachlorides remove the gas without having a grain refining effect. Titanium and stannic tetrachloride are the only ones which act as grain refiners as well as removing the gas. The tetrachlorides of Si, Sn and C and Al chloride, Fe chloride and acetylene tetrachloride degasify Al-Si alloys. (25)

INSPECTION (26)

Press for Tube Pieces. (Abdruckpresse für Rohrformstücke.) H. SONDERMANN. *Stahl und Eisen,* Vol. 51, Sept. 10, 1931, pages 1151-1152.

Illustrated description of a new press for hydraulically testing tubes. GN (26)

Modern Shop Methods for Testing, with Particular Reference to Optical Automatic Precision Instruments. (Neuzeitliche Werkstattmessverfahren unter besonderer Berücksichtigung optischmechanischer Präzisioninstrumente.) O. P. VAN STEEWEN. *Das Werkzeug,* Supplement to *Maschinenkonstrukteur-Betriebstechnik,* Vol. 7, Sept. 10, 1931, pages 177-180; Nov. 10, 1931, pages 193-197.

Describes gages, the Hirth-minimeter, optometers, microscopes, pitchometers, cog wheel testing apparatus, etc. etc. MAB (26)

Test for Smoothness of Machined Surfaces. F. A. FIRESTONE, F. M. DURBIN & E. J. ABBOT. *Metal Progress,* Vol. 21, Apr. 1932, pages 57-59.

The authors describe a device for amplifying and recording the irregularities on the surface of machined pieces by means of the angular movement of a mirror attached to a pointer tracing the surface. This movement is recorded photographically. WLC (26)

Optical Investigation of the Inner Walls of Hollow Bodies. (Optische Untersuchung der Innenwand von Hohlkörpern.) O. DAHNE. *Zeitschrift für Schweisstechnik,* Vol. 21, Jan. 1931, pages 12-15.

The novel optical outfit aims at the inspection of rolled or drawn tubes, hollow shafts, steel bottles, etc., with the object of detecting cracks, crevices, pores, corroded and pitted spots or other kinds of defects. The Zeiss "Rohrwandseher" permits examination of pipes of 18-400 mm. inside diameter and of any length practically reasonable. The magnification of the electrically illuminated spot depends on the diameter of the hollow body as follows:

inside diameter	magnification
40 mm.	4.4
80 mm.	2.9
100 mm.	1.8
200 mm.	0.9
400 mm.	0.5

Supplementary equipment permits the inspection of the bottom of cylindrical bodies and to take snapshots of the interior parts of cylinders. EF (26)

Reo Cuts Inspection Costs by Using New-Type Gages. *Iron Age,* Vol. 129, Jan. 14, 1932, pages 179-180.

Describes a few of the gages used, including the new electric type. For inspecting outside diameter of piston pins the new visual gage is used. The gage is actuated by a shadow which is magnified by passing through two condensing lenses. In the anvil of the gage is a strip of tungsten carbide, while on the end of a spindle is mounted a diamond. For measuring big end of connecting rods an inside indicator gage is used. This provides a three-point contact in the bore. A similar gage is used for small end of connecting rods. Crankshaft main bearings are checked by a Zeiss passometer caliper gage. The outside diameter of valve tappets is measured by a Sheffield electric indicator gage. For checking thread profiles and matching odd shaped surfaces a J. & L. Hartness comparator is used. VSP (26)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Calcium Improves Iron and Lead. C. L. MANTELL & CHARLES HARDY. *Metal Progress,* Vol. 21, Apr. 1932, pages 60-65.

A review of the properties, uses and manufacture of Ca. The metal is becoming increasingly important as a deoxidizer for cast Fe, steel and Cu. Cast Fe deoxidized with Ca has lower S and graphitic C and a higher tensile strength and impact value than Fe deoxidized by ordinary methods. Pb-Ca-Ba alloys, 2% Ba and 1% Ca, are finding some application as bearing metals. Pb-Ca alloys possessing higher fatigue resistance tensile strength and hardness than Pb-Sb alloys are coming into extensive use as sheathing material for electrical cables. Ca is used as a reagent for the removal of Bi during the purification of Pb. WLC (27)

Bismuth, Essential to Fusible Alloys, Has Additional Possibilities. W. C. SMITH. *Metal Progress,* Vol. 21, May 1932, pages 61-64.

Summarizes the properties, metallurgy, and recent applications of Bi. Ladle additions of 0.5% Bi to cast Fe increase fluidity to a substantial degree. Machinability and cleanness of castings is also promoted. Bi additions decrease tensile strength 70%. Analysis shows that only traces of Bi remain in the solidified Fe. WLC (27)

The Influence of Nickel on the Wear of Case-Hardened Steel. J. G. R. WOODVINE. *Carnegie Scholarship Memoirs, Iron & Steel Institute,* Vol. 20, 1931, pages 125-150,

30 references. The author reports a study of the comparative wear resistance of plain C, 1% Ni, 3% Ni and 5% Ni case-hardening steels which shows that with proper lubrication there is little to choose between the 4 steels though in service the 1% Ni steel is somewhat inferior. With dry rolling friction and abrasion by emery the plain C and 3% Ni steels are equal while the 1% and 5% Ni steels follow in descending order. With dry sliding friction the plain C steel is best followed by the 5%, 3% and 1% Ni steels in descending order. WLC (27)

Influence of Various Additions on the Properties of Gray Cast Iron. (Einfluss verschiedener Sonderbestandteile auf die Eigenschaften des Graugusses.) *Die Röhrenindustrie,* Vol. 24, Feb. 26, 1931, pages 53-55.

The effect of Cu, Pb, Mg, Mo, Bi, B, Ca, Ce, Sb, As, Co, V, Zn, Zr, In, Ti, Wo on the properties of gray cast iron is reviewed. 36 references. EF (27)

The Effect of Phosphorus on Cast Iron. (Der Einfluss des Phosphors auf Eisen.) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Mar. 6, 1932, pages 100-101.

Phosphorus in cast iron offers the following advantages: P bearing cast iron has a lower melting point and is thinly liquid so that the S of the cast iron can separate and the occluded gases can escape. GN (27)

The Use of Molybdenum in Alloy Steel Castings. W. H. Phillips. *Steel Founder,* Vol. 3, Mar.-Apr. 1932, pages 43-44, 57.

The addition of Mo to a steel imparts a deep hardening effect to heavy sections, ameliorates or even eliminates temper brittleness, widens the hardening range and simplifies heat treatment. A composition for a steel for exceptional service where shock and abrasion has to be met is given as C 0.25-0.35, Cr 0.7-0.9, Ni 1.75-2.25, Mo 0.15-0.25, Mn 0.7-0.9 It can be oil, water or air hardened and quenched from 1550° F. in water and drawn at 1000° to 1250° F. Several other compositions for various purposes are given. A comparison of a Cr-Ni steel with and without Mo at atmospheric pressure and 1000° F. gave the following results:

	without Mo		with Mo	
C	0.4		0.4	
Cr	0.8		0.8	
Ni	2.07		2.07	
Si	0.33		0.33	
S	0.011		0.011	
P	0.023		0.023	
Mo	....		0.29	
	70° F.	1000° F.	70° F.	1000° F.
Brinell hardness	232	.....	234	.....
Tensile strength	120,600	53,500	118,600	69,000
Yield Point	81,800	37,700	85,200	50,500
Elongation	21%	28%	20.1%	25.5%
Reduction	47%	56.5%	43.4%	71%
Loss in Heating From 70° to 1000° F.				
Tensile strength	63.7%		41.8%	
Yield Point	53.9%		40.7%	
Tempering temperature	920° F.		1290° F.	

Ha (27)

Impurities in Metals, Known and Unsuspected. Correspondence from A. Portevin. *Metal Progress,* Vol. 21, Mar. 1932, pages 69-70.

Notes on the effect of very small percentages of impurities in alloys. WLC (27)

The Behavior of Polonium in the Crystallization of Metals. (Ueber das Verhalten des Poloniums bei der Kristallisation von Metallen.) G. Tammann & A. v. Loewis of Menar. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 205, Apr. 8, 1932, pages 145-162.

While the distribution of impurities in metals and alloys is little known as metals are opaque the distribution of radioactive elements in metals can easily be detected even in minutest amounts, by electroscopic methods or photographically by the blackening action of the α rays on a plate. The production of Po alloys is described and the measurements showed that Po has only a very small tendency to form solid solutions. Saturated solid solutions contained only 2.31×10^{-11} to 5.28×10^{-10}% Po. Although Po is similar to Te it does not form the same compounds. Po is precipitated in the crystallization of Po-containing metals at temperatures which are considerably higher than the melting point of the polyeutectic. 13 references. Ha (27)

Excellent Properties Developed by Vanadium Alloy Steel Castings. Jerome Strauss & Geo. L. Norris. *Steel Founder,* Vol. 3, Mar.-Apr. 1932, pages 58-63.

Although V can serve as a deoxidizer it is not used for this purpose but added for its alloying qualities after deoxidation has been effected by cheaper elements. The percentage added is very small. A steel with only 0.05% V shows a much less marked dendritic segregation and a stronger, tougher and harder ferrite than V-free steels. These effects are shown in test results with several kinds of steel and in their micrographs; a number of castings are illustrated, especially large parts for locomotives, both steam and electric. Ha (27)

The Action of Cobalt in Carbon Steel under Consideration of technical alloyed Cobalt Steels, in Particular High Speed Tool Steel. (Ueber die Wirkung des Kobalts im Kohlenstoffstahl unter Berücksichtigung technischer legierter Kobaltstähle, insbesondere des Schnelldrehstahles.) E. Houdremont & H. Schrader. *Krupp'sche Monatshefte,* Vol. 13, Jan./Feb. 1932, pages 1-54.

It has been found that Co is a very good alloying material for tool steels, especially for saws. Also the magnetic properties are greatly improved. The investigation of the influence of Co on steel alloys is briefly summed up as follows; for the details of the exhaustive tests the paper must be referred to. Co increases in Fe-C alloys the α-γ transformation, with more than 40% Co the γ-range is widened. The addition of Co reduces the hardenability which causes less deformation and change of length when a Co steel is hardened. In annealed steel Co improves the strength at room and elevated temperatures. Co produces an increase in cutting capacity in high speed tool steel, and also in pure C steels. The addition of Co to these steels also increases the formation of austenite in hardening at high temperatures. An explanation of all phenomena is given by the structure of the steels which generally show an extremely uniform grain. A maximum of cutting capacity was found with 17% Co at 1280° C. hardening temperature. All tests are illustrated in curves and micrographs. Ha (27)

Tensile Properties of Cast Steel at Higher Temperatures with Special Regard to the Influence of Nickel. (Festigkeitseigenschaften von Stahlguss bei höhren Temperaturen unter besonderer Berücksichtigung des Einflusses von Nickel.) E. Piwowarsky & H. Nipper. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 5 pages.

See *Metals & Alloys,* Vol. 1, Oct. 1930, page 788. (27)

Aluminum in Brass. (Aluminium in Messing.) *Zeitschrift für gesamte Giessereipraxis,* Vol. 53, Mar. 20, 1932, pages 126-128.

Al contents in brass of from .25-2% impart favorable properties inasmuch as Al favors the separation of the impurities, the elimination of oxygen, improvement of the fluidity and casting properties, increase of the tensile strength and elasticity, improvement of forging and rolling properties. The special precautions to be observed in casting Al brasses are mentioned. They should be cast as slowly as possible. GN (27)

The Effect of Cobalt on Carbon and High Speed Steel. (Die Wirkung des Kobalts auf Kohlenstoff-und Schnelldrehstahl.) Edward Houdremont & Hans Schrader. *Archiv für das Eisenhüttenwesen,* Vol. 5, Apr. 1932, pages 523-534.

Study was made of 4 different types of steel, C varying from 0.10% to 1.04%, and Co from 0.04% to 24.0%, melts being conducted in (1) acid high-frequency furnace; (2) basic open-hearth furnace; (3) crucible melting high speed tool steel; (4) molten ingot steel additions made to graphite crucible containing molten Co. Effect of Co was established from 5 different angles: (1) On behavior during heat treatment of C-steel; (2) on mechanical properties; (3) on case hardening; (4) increased decarbonization; (5) increase in cutting work and causes. The authors found that Fe-Co alloys do not have to belong absolutely to systems with an extended γ-range. Moreover, the γ-range is diminished with low Co content and corresponding rise of transformation temperature. Only with high amounts of Co, above 40%, is the γ-range enlarged. Transformation trend of γ- into α-Fe in C-steel is increased, corresponding to rise in transformation temperature through small Co-additions, and from this it may be derived that transformation temperatures are more difficult to lower by means of speeding up cooling rates. This results in increased critical rate of cooling, and harmful effect on hardness. The increased trend towards structure change expresses itself further in a decrease in amount of residual austenite in tempered steel and in an accelerated dissociation of austenite during annealing. The decrease in hardness is related to a magnification in hardness range. The slight overheating sensitiveness of less rapidly hardened Co-steel is confirmed by less grain enlargement during cementation. A relation between grain size during cementation and hardness was discovered which, developed by addition of an alloying element, corresponds to behavior of abnormal steels. A withdrawal of temper carbon by loosening causes a switch over to difficultly soluble, stable carbides, or graphite precipitation. Reduction of border C-content during cementation signifies a decreased affinity of γ-solid solution for C, corresponding to effect of an element, that is weaker carbide-forming than Fe. Graphite precipitation occurs in large quantity only when Co-steels are annealed far below their transformation points. Graphite forming below transformation may be eliminated by heating in γ-range followed by water quench or air cooling. This gives a high diffusion of C in cobaltous γ-solid solution, which may likewise be observed during cementation. A confirmation of small carbide stability and accelerated migration velocity of C in γ-Fe was obtained from the strongly decarbonizing Co-steels. Co in annealed steel improves its strength at atmospheric and elevated temperature. It is apparent that this change in strength properties, that indicates difficult particle separation, is related to decrease of lattice parameter and stronger atom combination with shorter space lattice plane distance. Improvement in work, obtained from high speed steel by Co addition, steadily increases on normal tempering at 1280° C. up to 17% Co. Similar improvement may be obtained with C-steels provided sufficient hardness is produced from the impaired physical property. Better cutting performance of Co alloy steels depends probably upon the increased hardness stability during annealing and higher hardness under heat. The improved hardness permanence depends on the rise in mechanical strength of the nucleus when the carbide conglomeration is retarded. Retarding of precipitation reaction and carbide conglomeration by Co changes the hardness slope during anneal to higher temperatures and longer annealing periods. This action is proved jointly with the heat hardness, which gives better cutting performance. The latter is produced by improved hardening through the effect of grain structure as well as by increased heat strength of the principal constituent, α-Fe. Included are 16 references, 2 tables 22 graphs, which well illustrate each important experiment. DTR (27)

The Influence of the Elements Silicon, Phosphorus, Aluminum, Nickel and Chromium on the Quasi-Isotropy and the Wall Thickness Sensitivity of Cast Iron. (Ueber den Einfluss der Elemente Silizium, Phosphor, Aluminium, Nickel und Chrom auf die Quasiisotropie und die Wandstärkenempfindlichkeit von Gusseisen.) E. Piwowarsky & E. Söhnchen. *Mitteilungen aus dem Giesserei-Institut der technischen Hochschule Aachen,* Vol. 2, Oct. 1931, 4 pages.

See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 25. (27)

INSTRUMENTS & CONTROLLERS (28)

Measurement of the Electrical Conductance of Non-Metallic Pipe Coatings. E. R. SHEPARD. *American Gas Journal,* Vol. 136, June 1932, pages 22-26.

Measuring coating conductance is more difficult than measuring conductance of a metallic circuit or an electrolyte. The nature of conductance of coatings has been divided into 3 parts, namely, that due to large holes, that due to capillaries, and that due to inherent conductance. Conductance through capillaries is usually the chief component and any factor which changes or moves the electrolyte within the capillaries is likely to affect materially the total conductance of the coating. The conductance of a coating therefore is not a fixed or definite value but is indefinite and unstable. A complete description of the direct current test set for measuring coating conductances as well as a discussion of the technique of field measurements is given. CBJ (28)

The Effects of Heat Treatment on Fine Metallic Suspensions. N. N. ZIRBEL. *Physics,* Vol. 2, Mar. 1932, pages 134-138.

When a suspended system, such as is incorporated in a torsion balance or galvanometer, is supported by a fine wire the equilibrium position usually changes slowly for a long time after the load is applied. The equilibrium position of the system also changes with temperature. It has been found that both of these disturbing factors can be eliminated by a suitable heat treatment of the wire. Observations have been made on tungsten and platinum-iridium wires of sizes suitable for use in the Eötvos torsion balance. Although it is not pointed out in the paper the heat treatments involved were essentially annealing treatments, and most probably relieved the strains set up in the wires during fabrication. WAT (28)

The Value of Accurate Measurement. J. A. S. RITSON. *Iron & Coal Trades Review,* Vol. 124, Jan. 15, 1932, pages 50-81; Discussion, Feb. 19, page 325.

The great economical value of installation of exact measuring instruments, particularly for use in the generation, transmission and transformation of power is pointed out and examples given of losses accruing by faulty instruments or faulty arrangements of them. Ha (28)

International Standard of Electromotive Force. MARION EPPLEY. *Electrical Engineering,* Vol. 51, May 1932, pages 341-343.

Cd cells have proved to be convenient and reliable sources of standard e.m.f. Materials require careful chemical treatment. Hg_2SO_4 is particularly sensitive but when mixed with finely divided Hg can be prepared by electrolysis. Hg must be redistilled after an acid wash, and $CdSO_4$ should be of high quality. The use of the standard cell and the care and handling of it are briefly outlined. WHB (28)

Construction of Thermo-Elements by Electrodeposition. H. KERSTEN & R. SCHAFFERT. *Review of Scientific Instruments,* Vol. 3, Apr. 1932, pages 189-195.

The ordinary methods of thermocouple construction by joining 2 metals by soldering or welding are, in the method herein described, replaced by joining the metals by electrodeposition, making use of the fact that most metals plated on stainless steel may be peeled off easily. The manner of doing this is described in detail, the compositions of plating baths for Co, Ni, Cu, Cd, Fe, Ag and brass are given. This method can also readily be used for the plating of junctions in series, as for instance for bolometers or thermopiles. The advantages of this method are that it eliminates the difficulties of soldering together a number of small wires, that the mass of the junction can be reduced to a minimum, and especially, that the junction may be used at a higher temperature than soldered junctions. Ha (28)

The Duroscope. (Das Duroscope.) A. SCHWARZ. *Zeitschrift für Metallkunde,* Vol. 24, Apr. 1932, pages 93-95.

A description of the "duroscope," a hardness tester. Curves for the conversion of duroscope hardness values into Brinell numbers are given for C-steels, Cr-Ni steels, Al and brass. RFM (28)

The Testing of Inner Walls of Highly Stressed Hollow Cylinders for Material Defects by Photography on Continuously Moving Film. (Die Prüfung der Dünenwandung hochbeanspruchter Hohlzylinder auf Materialfehler mit Hilfe des photographischen Aufnahmeverfahrens auf ständig bewegtem Filmband.) R. LOENHARDT. *Feinmechanik und Präzision,* Vol. 39, Sept. 1, 1931, pages 127-132.

The Askania Works, in coöperation with the AEG-Berlin, have developed a camera with an objective prism in a pipe of 3.25 m. length which can be introduced into the opening of tubes, pipes, hollow cylinders etc. for continuously photographing the inner surface. The theory of the apparatus, adjustment of speed in relation to the dimensions is explained and the construction and pictures taken illustrated. A special reproducing apparatus has been developed for this film. Ha (2

Control of Tunnel Kilns by Measuring Instruments. (Die Brandführung von Tunnelöfen nach Messgeräten.) W. LIESEGANG. *Berichte der deutchen keramischen Gesellschaft,* Vol. 13, Jan. 1932, pages 1-13.

The article gives a comprehensive survey on the value and the arrangement of temperature recorders for supervising tunnel kilns which are either coal fired, gas fired, or electrically heated. Extensive temperature measurements were carried on on all 3 of the above type kilns. Information is also given on the composition of the fuels, waste gases and the fuel consumption. GN (2

Use of Micropyrometer for High-Temperature Melting Point Investigations. G. R. FITTERER & M. B. ROYER. *Report of Investigations* No. 3151, *United States Bureau of Mines,* Mar. 1932, 18 pages.

A recording micropyrometer for the determination of the melting point of refractory oxides is described. It is accurate for determinations using stable compounds, eutectics and pure oxides. The accuracy is decreased with materials which have wide temperature ranges of solid-liquid immiscibility. 54 references. AHE (28)

Measurement and Regulation of Temperatures in Metallurgical Furnaces (Ueber Temperaturmessung und regelung in metallurgischen Oefen). F. KOFLER & G. SCHEFELS. *Stahl und Eisen,* Vol. 51, Dec. 10, 1931, pages 1529-1535.

After outlining the difficulties in continually measuring the temperatures of metallurgical furnaces, the authors show that these difficulties can be successfully overcome by optical measuring methods. Such an optical measuring method is described and illustrated in some examples as, for instance, open hearth furnaces, rolling mill furnaces, mixers, and rolling mills. The paper, furthermore, deals with automatic temperature recorders, describes the installation, working and recording. 2 references. See also *Metals & Alloys,* Vol. 3, Mar. 1932, page MA 82. GN (28)

Use of the Tungsten-Molybdenum Thermocouple. D. BINNIE. *Journal Institute of Fuel,* Vol. 5, Feb. 1932, page 211; Abstract in *Electrical Review,* Vol. 109, Dec. 18, 1931, page 918.

As some precious metals have a very short useful life at high temperatures, the use of W and Mo for temperature measurement in the form of thermocouples was investigated. The junction was not easy to weld properly due to the high melting-points of the metals, but twisting one end of the wire tightly round the other gave satisfactory results. The thermo-electric curve is approximately parabolic in shape. The useful range of the couple is from 1200° C. upwards, the upper limit being the softening point of the furnace refractory material. At 1600° C., although the actual e.m.f. developed is small, the power is more than 8 microvolts per degree. Variability of the couple in use was tested by taking heating and cooling curves of a specimen of Armco iron, melting point 1530° C. Even after soaking at temperatures of over 1600° C. there was no alteration in the e.m.f. at the freezing-point of the iron, nor at the δ-γ transformation at 1403° C. Portion of the couple exposed to high temperatures in a H_2 atmosphere always became extremely brittle, particularly the W wire, and could not be subsequently cold worked. Use of the couple at high temperatures and particularly in oxidizing atmospheres, depends on an adequate protecting sheath. Highgrade porcelains are claimed to be impervious to gases up to 1750° C., and in the hands of a careful operator there seems to be no reason why accurate temperature measurements up to this point should not be obtained in combustion atmospheres. MS (28)

The Regulation of Temperatures in Industrial Furnaces. (Ueber die Regelung der Temperatur in industriellen Ofen). V. PASCHKIS. *Forschung auf dem Gebiete des Ingenieurwesens,* Ausgabe A., Vol. 2, Jan. 1931, pages 29-43; Feb. 1931, pages 57-61.

The characteristics and sensitivity of temperature regulation are discussed and exhibited in graphical form. WHB (28)

Automatic Heat Control of Open-Hearth Furnaces. (Selbsttätige warmetechnische Ueberwachung von Siemens-Martin-Oefen.) C. SCHWARZ. *Stahl und Eisen,* Vol. 52, June 2, 1932, pages 542-543.

Condensed summary and discussion from the literature, of automatic control and supervision of open-hearth furnaces. Use of instruments to get automatic control of fuel needs, air for combustion, draft and temperature measurements, waste gas analysis, gas pressure, heating value and composition of fuel, appears to be good modern practice. DTR (28)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Varnishing, Patina and Painting of Copper. (Vernissage, Patine et Peinture du Cuivre.) H. BREAU. *Cuivre et Laiton,* Vol. 5, Mar. 15, 1932, pages 113-115.

Usually Cu does not need to be covered with a protective coating; only if the brightness of new Cu is to be preserved or in order to harmonize decorative effects an artificial coloring is applied. In the former case, transparent cellulose varnishes are recommended. The green patina, natural or artificially provided is a good protection and besides gives fine and harmonizing effects with the surroundings for decorative purposes. For covering with a paint the Cu should not be polished too brightly as the paint will not adhere. Ha (32)

Serial Tests on White Paint Coatings in Regard to Atmospheric Stability and Rust Protection Power. I. Results from a Testing Period of 1½ years. (Bericht über die Ergebnisse einer Reihenuntersuchung von Weissfarben-Aussenanstrichen auf Wetterbeständigkeit und Rostschutzvermögen. I. Teil. Ergebnisse nach 1½ jähriger Versuchdauer.) E. MAASS & R. KEMPF. *Korrosion und Metallschutz,* Vol. 7, Oct. 1931, pages 237-242; Nov. 1931, pages 265-275.

Experiments were carried out which refer to 144 different coatings on mortar plaster, to 61 coatings on pine tree planks and to 102 coatings on iron plates. The original paper must be consulted for detailed information on the results which are presented in 6 illustrations each of which comprises 15-24 different samples (330 in total) and in tabular form which allows one to pick up at a glance the summary of the visual examination. (1) Confirmatory evidence was found in regard to the beneficial effect of non-oxidizing oil and of wood oil and of mixtures of both respectively. (2) Additions of benzin lacquer are detrimental, which effect however can be eliminated by the use of wood oil-non-oxidizing oil mixtures. (3) Oil saving lithopone never proved to be worse but usually better than purely precipitated material. (4) A marked superiority was noticed in the case of coatings containing Pb-chromate. The yellow discoloration, however, may prevent a wider adoption. EF (32)

Modern Methods of Enameling Cast Iron. J. H. D. BRADSHAW. *Foundry Trade Journal,* Vol. 46, Mar. 10, 1932, pages 162-165.

Paper read before the Birmingham branch of I.B.F. deals with the preparation of enamel, the calculation of enamels, the preparation of castings for enamelling, and, in conclusion, compares the results obtained by the dusting process and by the wet process. Some attention is devoted at the end of the paper to modern enamelling furnaces and to improvements that have been made in furnace appliances. OWE (32)

Manufacturers' Literature Reviews

534 **Nickel Alloy Steel Castings**—A pamphlet discussing the applications of nickel steel castings, the design of castings, the effect of alloying elements on cast steels and methods of adding alloys to steel has been prepared by the International Nickel Co., 67 Wall St., New York, N. Y. This is Bulletin No. 8-A of their Nickel Steel Data and Applications series. The 1932 issue of their Buyers' Guide for Nickel Alloy Steel Products is now available.

535 **KloiZenay**—The General Alloys Company, South Boston, Mass., have developed "KloiZenay," a colored glass poured on the casting so that the silica of the glass fuses with the metal.

536 **Alloy Steel Castings**—A recent pamphlet issued by the Lebanon Steel Foundry, Lebanon, Pa., is devoted to their alloy steel castings for high stresses and wear resistance and their stainless alloy steel castings for heat and corrosion resistance.

537 **Heat Treating**—A card recently sent out by the American Metal Treatment Co., Elizabeth, N. J., describes their nitriding, coloring and carburizing service as well as their "Machlet Ni-Carb-Case," a combination process of nitriding and carburizing.

538 **Metallizing**—Several leaflets sent out recently by the Metallizing Co., Los Angeles, Calif., describe their metal spray coating process and its applications.

539 **Truing Tool**—The Carboloy Co., Detroit, Mich., has sent out a leaflet showing the advantages of using the Carboloy truing tool for finish dressing a wide range of grinding wheels.

540 **Furnaces**—Bulletin No. 335 of the W. S. Rockwell Co., New York, N. Y., is devoted to their roller hearth furnaces, electric and fuel fired, for continuous heat treatment of metals.

541 **Valve Spring Wire**—A pocket-size booklet prepared by the Wickwire Spencer Steel Co., New York, N. Y., discusses the manufacture of their valve spring wire, its heat treatment and inspection. A table showing the tensile strength of various gages of the wire is included. The same company has prepared a booklet devoted to their welding wire.

542 **Die Blocks**—A leaflet sent out by the Heppenstall Co., Pittsburgh, Pa., discusses the manufacture of their die blocks. A pamphlet prepared by the same company is entitled "Serving Industry for Three Generations" and contains a short history of the company, describes their metallurgical service and facilities, and illustrates their products.

543 **Refractory Cements**—The different grades of their refractory cements are itemized in a booklet sent out by the Carborundum Co., Perth Amboy, N. J. Bulletin 6-A of the same company is devoted to their recuperative malleable iron air furnaces.

544 **Salt Baths for Heat Treating**—The J. W. Kelley Co., 13209 Athens Ave., Cleveland, Ohio, has sent out a leaflet giving the characteristics and applications of their various kinds of salt mixtures for use in heat treating.

545 **Protected-Arc Electrode**—The Hollup Corp., 3333 West 48th Place, Chicago, Ill., has sent out an announcement of their "Sureweld," a new protected-arc electrode.

546 **Jointing Material**—A leaflet distributed by the Cling-Surface Co., 1032 Niagara St., Buffalo, N. Y., describes the use of "Permac," a dry metallic powder for making flange and other joints without the use of packing.

547 **Weld it Well**—A booklet with this title has been issued recently by the Harnischfeger Corporation, Milwaukee, Wis. It is a fully illustrated book on the latest developments in welding practice and welder design, one double-page spread being a cross-section diagram of an arc welder. Bulletin HW-2.

548 **Cold Mills**—Bulletin P-202 of the United Engineering & Foundry Co., Pittsburgh, Pa., describes and illustrates their Precision cold mills, 2-high, 3-high, and 4-high, for the cold rolling of sheets and strips in all commercial metals, from heavy gages down to thinnest foils and flat wires.

549 **Eraydo**—The second edition of "Reference Data on Eraydo" has been issued by the Illinois Zinc Co., 332 So. Michigan Ave., Chicago, Ill. Eraydo is a zinc base alloy containing silver and copper to form a tough metal, said to be adapted to deep drawing, extruding and forging. The handbook describes it, gives its physical, chemical and electrical properties and illustrates many of its applications.

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Alphabetical Index to Advertisers

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Dr. Charles F. Barrett and Dr. Dana W. Smith are now working under Dr. Mehl at the Bureau of Metallurgical Research. Dr. Barrett formerly of the Naval Research Laboratory at Washington is working in the capacity of Physicist and Dr. Smith, who was a graduate student at Yale last year, is now at the Bureau working as the Assistant Metallurgist.

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550 **Fluid Meters**—Bulletin No. 300 of the Bailey Meter Co., Cleveland, Ohio, describes and illustrates several types of meters and deals with their applications and methods of installation.

551 **Corrosion and Heat Resistant Steels**—Bulletin No. 30-9 of the Wehr Steel Co., Milwaukee, Wis., gives the physical analysis of the Wehr corrosion and heat resistant steels.

552 **Copper**—The Oct. 1st issue of the Bulletin of the Copper & Brass Research Association, 25 Broadway, New York, N. Y., pictures a number of interesting applications of copper and bronze.

553 **Furnace & Burner Equipment**—A recent bulletin of the Surface Combustion Corp., Toledo, Ohio, is devoted to their burner equipment, standard furnaces and continuous furnaces for annealing, carburizing, hardening, normalizing, nitriding and forging.

554 **Electric Furnaces**—Bulletin 4a of the Ajax Electrothermic Corp., Trenton, N. J., describes and illustrates their 3 kva. converter and furnace, by means of cross-section diagrams.

555 **Cast-Refract**—A pamphlet sent out by the Quigley Co., 56 West 45th St., New York, N. Y., describes their "Cast-Refract," a new type of refractory which can be cast or molded on the job and can be put under full heat within 24 hours. It is said to have excellent refractory properties up to 2600—2800° F.

556 **Pipe Bending**—Bulletin No. 50 of the A. M. Byers Co., Pittsburgh, Pa., is entitled "Principles and Practice of Bending Byers Genuine Wrought Iron Pipe." It describes what happens when pipe is bent and gives the minimum diameter of bends which can be made in various sizes of pipe.

557 **Arc Welders**—A leaflet sent out by the Universal Power Corp., 12367 Euclid Ave., Cleveland, Ohio, describes their portable road trailer type arc welders.

558 **Chemicals**—The winter price list of the Roessler & Hasslacher Chemical Co., New York, N. Y., has just been issued. Prices of chemicals for all industries are shown.

559 **Tool Steel**—A number of folders have been prepared by the Columbia Tool Steel Co., Cleveland, Ohio, each devoted to one of their tool steels. The applications, machining, forging, annealing, hardening, tempering and grinding of each steel are given.

560 **Controllers**—The Automatic Temperature Control Co., Inc., Philadelphia, Pa., has issued several leaflets describing their motor operated controllers, valves for fuel oil and relays.

561 **Steel Chain**—The Link-Belt Co., Chicago, Ill., has just issued an illustrated 144-page catalog on steel chains ranging in size from small chains having an ultimate strength of 950 lbs. to powerful chains of 1,500,000 lbs. strength.

562 **Electric Metal Heaters**—Several types of electric metal heaters are described in a folder sent out by the American Car & Foundry Co., New York, N. Y.

563 **Controller**—A circular sent out by Lucius Pitkin, Inc., New York, N. Y., discusses the Tour temperature controller and its points of superiority.

564 **Whiting Founder**—A late issue of this publication of the Whiting Corp., Harvey, Ill., contains articles entitled "Pulverized Coal in the Foundry," "Material Handling in the Foundry" and "Converter Steel."

565 **Seamless Tubing**—The use of seamless tubing for making parts is economical according to a folder issued by the National Tube Co., Pittsburgh, Pa.

566 **Springs**—An article entitled "Helical Torsion Springs" is the feature article in a recent issue of the *Mainspring*, a publication of the Wallace Barnes Co., Bristol, Conn.

567 **Price Card**—The Republic Steel Corporation, Youngstown, Ohio, has issued a new price card, effective Oct. 1, 1932, on Toncan Copper Molybdenum Iron Pipe. It embodies a simplified method of computing prices and shows slight changes in prices of various sizes of the pipe.

568 **Data on Heating-Unit Design**—The Hoskins Manufacturing Co., Detroit, Mich., has prepared a convenient card for determining the length of wire necessary in designing coiled units using Hoskins-Chromel "A."